# Industrial QUALITY CONTROL

Vol. XIV, No. 1
July, 1957

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Selling Quality Control to Management

How to Use Practical Calculations in the Use of Hotelling's T

The 1956 Shewhart Medalist's Address

Eleventh Annual Convention Report

QUALITY
through
Scientific Methods

Journal of the
AMERICAN SOCIETY FOR QUALITY CONTROL

Giant over-the-horizon antenna designed by Bell Telephone Laboratories for "White Alice," Air Force Alaskan defense communications network.

# *How UHF radio got seven-league boots*

THE huge antenna systems which project ultra-high frequency radio communications beyond the horizon began when a Bell Telephone Laboratories engineer became intrigued with a strange phenomenon. Although these radio waves were supposed to be useful only over line-of-sight distances, the waves displayed a mysterious tendency to take off in a giant stride to antennas beyond the horizon.

This phenomenon had been studied both here and abroad, but no practical use was seen until the engineer became interested and thoroughly sifted the experimental data. He came up with the stimulating conclusion that over-the-horizon transmission is far stronger and much more dependable than was generally supposed. Further he predicted that it could be utilized to supply dependable broadband communications. He and his associates at Bell Laboratories confirmed the prediction experimentally, then drew up requirements for the first over-the-horizon UHF transmission system.

This pioneer work at Bell Telephone Laboratories has greatly increased the usefulness of UHF communications. For example, over-the-horizon transmission now provides critically important communications between remote military outposts in the Arctic and in the far north.

For the Bell System it can provide important new links for telephone conversations and television.

Kenneth Bullington, B.S.E.E., University of New Mexico; M.S., Massachusetts Institute of Technology; recipient of the 1956 Morris Liebmann Memorial Prize and the 1956 Stuart Ballantine Medal for his contributions in the field of over-the-horizon ultra-high frequency radio transmission.

Experimental antenna used in early over-the-horizon UHF radio transmission research. Research extended transmission from 30 miles line-of-sight to 200 miles.

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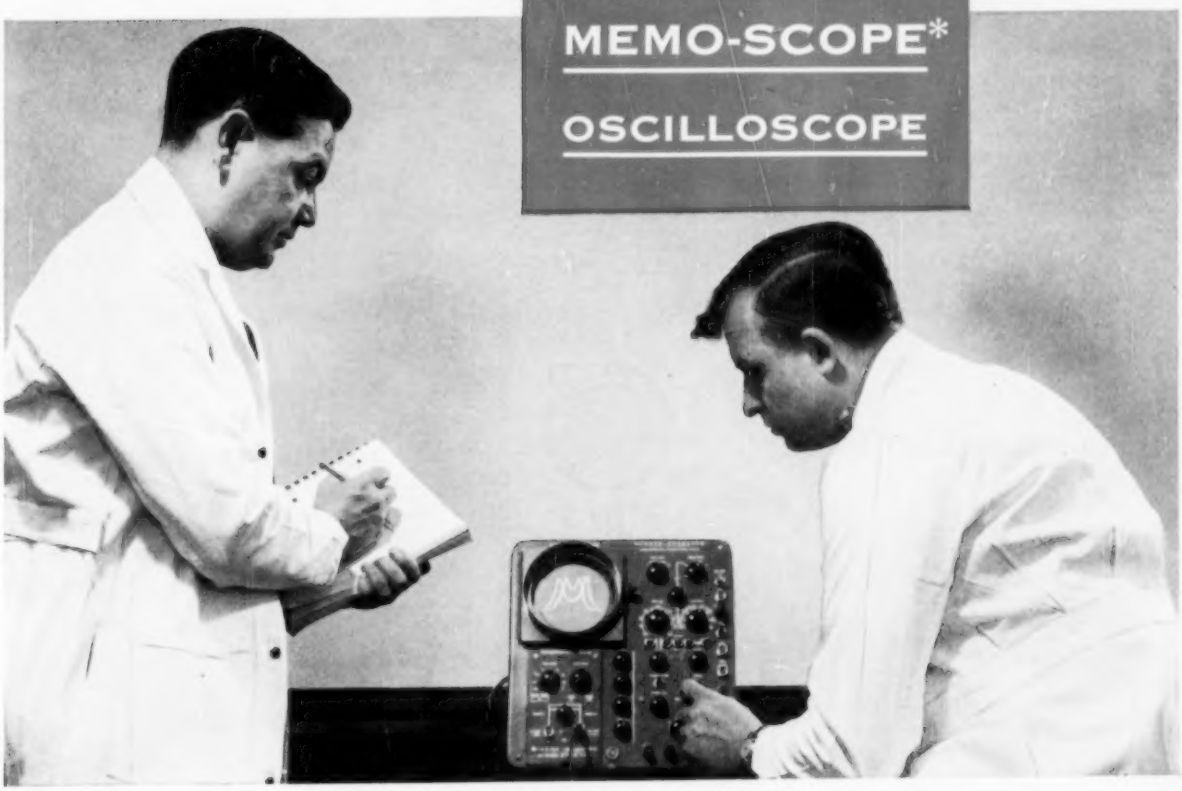

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# *From the President's Desk*

## We Need Management's Recognition

WE ARE now moving into a new year of Society activities with a continuing determination to bring the quality control story to more members of top management. One vital key to the future progress of our science is a fuller understanding and the intelligent support of quality control by upper echelons of management. We all know the tremendous potential economic impact of SQC applications, but the general interest which we will be able to stimulate is a function of the degree of importance which upper management attaches to our work. This general interest will, in turn, increase our membership and help to propogate an advancement and diffusion of available knowledge in the field.

Your Society officers urge each section to sponsor a "Management Looks to Quality Control" panel this year so that we can present a united front in emphasizing this important subject.

We recommend the use of at least two speakers for a management meeting—one who is well conversant with quality control and the other an outstanding member of upper management. The first would describe some of the basic concepts of Quality Control in a non-technical manner. The second would discuss the value of SQC in his own plant. As a top management representative acquainted with the success of quality control in his own company, he can talk quality control convincingly to other executives attending the discussion. Several vice presidents and presidents of companies using quality control effectively have already agreed to accept at least one section invitation, and arrangements are being made with others. To arrange for a special night conference panel, or other management-directed meeting write to:

Robert G. Mitchell, International Latex Corp., Dover, Del.

THE Program and Speakers' Commitee, under the chairmanship of Professor David S. Chambers of the University of Tennesseee in Knoxville, is prepared to offer services designed to aid sections in further implementing this program.

The ASQC Lecture Series is a way of securing outstanding quality control speakers from distant parts of the country to address your section. Because of their caliber, these speakers can command the attention of your management. By cooperative effort, adjacent sections can schedule one of these lecturers to speak on successive evenings with optimum conservation of time, travel, and expense. These lectures can bring about a healthy interchange of SQC ideas and practices throughout the country.

Paul K. Leatherman, 6052 Pernod Avenue, St. Louis 9, Missouri, is already arranging several lecture series for this year. If you are interested, write him for details.

IF YOU have a problem in finding speakers for regular meetings, we suggest that you write one of the following for assistance:

NORTHEAST: Rocco L. Fiaschetti, Ansco-General Aniline & Film Corp., Binghamton, N. Y.

EAST CENTRAL AND MIDWEST: Henry Jacobson, P. R. Mallory Co., Indianapolis, Ind.

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SOUTHEAST: Ralph Bradley, Virginia Polytechnic Institute, Blacksburg, Va., *or* Allen Haskell, U. S. Steel Co., T.C.I. Division, P.O. Box 599, Room D-315, Fairfield, Ala.

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OR you may contact F. Bruce May, General Coordinator of this activity, at Johnson and Johnson, New Brunswick, N. J.

Another valuable aid to the program planning is the ASQC Speakers List. Here in one compact publication are the names of 300 speakers, together with the titles of papers and information on travel expenses. A copy may be requested from Henry Jacobson, P. R. Mallory Co., Indianapolis, Ind.

But the spotlight at your program for the year is MANAGEMENT NIGHT. Plan to participate in it.

Leon Bass

# How to Sell Quality Control To Management*

ROBERT M. LaFORGE

*The University of Tennessee, Knoxville, Tenn.*

• Selling quality control is like selling anything else. First there must be a salesman with a product, and there must be a prospective customer to whom the product can be sold. In this discussion let us begin with some assumptions in order to have these essential elements to talk about. Let us assume first that you are a part of the staff or lower echelon of the "line," a junior executive of some sort, and that you have an enthusiasm for quality control. It may be that you are a newly appointed quality control supervisor, or you may not have that responsibility at all. In either case the sales job may be yours, and it may be equally difficult in whichever position you occupy. You are the salesman. You are the one who must sell quality control to someone else.

As to the second essential element, I am assuming that you not only believe in quality control yourself, but that you know enough about it to sell it. Let us further assume that the prospective customer, who will be referred to hereafter as "the prospect" is your production manager, superintendent, factory manager, chief engineer, or some other person who knows little or nothing about the subject and perhaps has shown a lack of interest in these "newfangled ways."

• Textbooks on sales technique point out that there are at least five conditions which must be met before a good sale can be accomplished.

First, it is necessary to make the prospect aware of the product. This is usually accomplished by advertising, sales letters, or even personal contacts.

Second, a favorable atmosphere must prevail throughout the period of advertising, approach to the prospect, and the selling period itself.

Third, the prospect must be made to *want* the product. It is necessary to create within him the feeling that not only is the product a good thing, but that he wants to have it.

Fourth, if the sale is to result in a satisfied customer, it is necessary that the product be worthwhile, a really good product, worth the investment, and expected to result in continuing satisfaction.

And fifth, the salesman must watch the customer to know when to "close" the sale by asking for a commitment by the prospect. It is essential to keep after the prospect long enough to get the commitment, and equally important to know when to leave him alone and not spoil the sale by "overselling."

Let us outline a chronological procedure which is general enough to cover the more difficult cases. We might call this the outline of fundamentals for a "good sale."

• The first step is often called the preparation. It is necessary to develop a plan of attack to sell the right man in the organization, and to concentrate on selling him. In selecting the man, choose carefully someone who is high enough in the management to be influential. He should be one whose opinion will be respected by a large group of supervisors or a large segment of the organization. After you have worked in a company some time, you find which individuals are more influential than others, and which ones you can expect to help you the most. Specifically, they would be those whose influence is felt in the area you wish to sell on quality control.

The prospect you select must have considerable authority if he is to be able to extend your own influence. It would be well if he were the one who controls or directs the department where you would like to initiate activities. By selecting his area for your first successful demonstration, you might enlist his support in carrying the program to other areas.

It would be advantageous to determine something about his ambitions for his work, and to plan to gain his support by appealing to this interest. For example, he might be most responsive to something which might reduce costs of operation in his department; or perhaps he prefers over-all reduced costs to the company; or he may be interested in anything that will produce better quality in his department. Some need a personal incentive, such as an opportunity to get ahead of other supervisors, or (if some bonus scheme is operating) to increase personal earnings.

• In any event, study your man carefully. Investigate the status of his knowledge of statistical quality control. Find what study he has made, and if he has expressed any opinions about it. It will help if you can determine any misconceptions that he has about statistical quality control. You can then be prepared to straighten this out at the proper time later on. Salesmen often find it worthwhile to explore what outside interests can be used to approach and interest the prospect. Move slowly, checking carefully, reminding yourself that a worthwhile program cannot be attempted overnight, and that it will pay to take the time to get the support of this individual.

You might begin by routing background information to him. This could be occasional "success" articles featuring the benefits of SQC, or comparable advertising copy which is often found in trade journals, and even in popular magazines. Select those stories which indicate that plants with processes or problems similar to yours have tried and successfully used the techniques that you want to introduce. If possible, show evidence that the technique is being tried or used by a competitor.

*An Address given before the Quality Control Conference sponsored by the Birmingham and Huntsville Sections of ASQC at the University of Alabama on October 13, 1955.

At some appropriate time you might invite him to attend a meeting where you know that the subject of SQC will be discussed. Another suggestion is to arrange a meeting between your prospect and someone whose opinions he respects to advise him of the opportunities of using these techniques.

• When you feel that the time is right, arrangements should be made for your "trial balloon." The right time is when he needs some assistance; when things are not at their best. Avoid the period when everything is going well or better than usual. When quality is slipping or costs are higher, you can expect a better response. If all is going well you may have to wait or find someone else to work on until the appropriate time does come. When you raise your "trial balloon," be sure to do it correctly, by getting the proper clearances and the authority to make "some studies." In making the preliminary arrangements, try to get your prospect to participate, or at least assign someone from his staff to actively participate.

Carefully select the operation to be studied. It should be something that is a continuing project with a chronic record of rejects above what seems reasonable. It should have the elements needed to show high potential savings, high volume or high cost, and a high scrap or rework history.

Go over the history of the operation, reviewing each step in the existing procedure, and (if possible) variations which have been used and discarded in the past. Talk with everyone who might shed light on the problem. Get the operator to express his opinion as to what causes inperfections, etc. Discuss it with the foreman, and the assistant foreman who are directly responsible for this operation. Be sure to include the maintenance personnel who work on the apparatus, for they may be able to add a different point of view and often new knowledge and opinions that you need. In your discussions with these people you may find it necessary to justify your interest and your actions. It is always easy to explain that you are "collecting data to study for cost reductions," "making an analysis of costs," or some similar noncommittal statement if you are afraid of tipping your hand too soon.

• When all is ready, go over the details with the foreman, explaining what is to be done, how, when, and where. The first step will be merely the collection of measurement data or additional inspection and it will pay to get the advice of the foreman as to which operator to study, and to have him help you get all arranged. If possible get the foreman to assist as much as you feel he can without imposing on him.

Collect your data quietly, but accurately. If it seems advisable, plot a chart of something to be able to show curiosity seekers. Never act as if anything you are doing is a secret. Explain readily (if asked) to workers, staff, or foremen exactly what figures you are measuring and how you are recording them. It might be well to venture no further explanations of their ultimate purpose than that they are for some studies which may help in reducing scrap, improving quality, or reducing cost. At this stage of the project, do not put any limits on charts. If you want to calculate limits, keep them to yourself.

• Remember that you are merely collecting data. You have discussed this with everyone and you know their opinions as to what is expected, but you do not know the results. Postpone any tendency you may have to arrive at premature conclusions based on inadequate data. Remember also that the first data collected may be poor due to nonuniformity in measuring, unfamiliarity with instruments or conditions, and even operator bias due to your presence.

It may be several days before you will be able to get results that are trustworthy enough to prove anything. When you do have something, inform the proper individual first. This may be the foreman, the floor inspector, the maintenance foreman, or perhaps your prospect. The choice depends on what you may uncover. If the trouble appears to have been a matter of failure to follow prescribed methods, it is a matter to take up with the foreman. If the equipment is at fault it may be the maintenance foreman is the proper one to approach. In any event, results that prove something should be shown to the prospect and discussed with him. As corrective action brings about a change in your data, this should be shown to all concerned, and your prospect should be encouraged to study the results.

One of the difficult phases in handling a situation like this may be the disproving of theories which contradict the correct answer. In your original investigations, it may be that you talked with someone who had an incorrect theory concerning the basic causes of trouble. If your study proves that some other cause is the correct answer, you must be prepared to disprove his theory as thoroughly as you support your own. In explaining results like these, it is necessary to show consideration for others and to use tact. Each of us really wants to know the truth, but we would like to have things work out so that our own idea proves to be correct, rather than the other fellow's idea. It may require additional studies to collect data that can be used to disprove these contradicting theories, but be sure that you work honestly, really giving them each a "fair trial." Otherwise some future study may disprove your findings, and undo all the good you are accomplishing.

• After you have assembled the results of your investigation, present them to your prospect. Point out the good features and advantages over existing procedures. As you go over the figures, encourage him to estimate the possible savings. You do not have to let him know that you worked them out long before, unless he asks you for them directly. Emphasize that by using this technique he can achieve even more than was possible on this preliminary study.

Outline to him a procedure whereby he can utilize this technique. You might offer to make all the calculations to begin with, and to train him or someone he designates to take over, once things get safely started. In making a sale it is said that one of the most important phases is the close. Get him to agree to have someone in his staff or organization learn to continue the studies under your guidance. If he once appears to be sold, stop throwing any further sales effort his way and shift instantly to encouragement and commendation with some such remark as "I'm sure you will not regret this action." Bring up no new selling point after this, or you may upset the sale. It is possible to oversell, just as surely as it is possible to undersell.

• It is probably well to follow up your initial activity with a well-written report of the results, emphasizing throughout the effort, suggestions, and work done by everyone except you. By pointing up the contributions of those who participated, it will be a lot easier to get these same people to lend their support to your next proposal. It will also demonstrate that the technique which you are trying to sell is no "voodoo" or magic known only to you, but rather is a worthwhile tool which others can use with profit.

Have available a carefully thought out plan for the next steps which

you intend to propose in introducing SQC to other applications in the plant. Your plans should be backed up with some estimate of the costs for future studies, so that you can discuss this aspect if asked. Do not come out with any of these estimates until the appropriate moment, and then remember to go slowly. Be careful to caution those who come in to support the program that it must grow slowly. It is possible to get overenthusiastic and allow a few poorly planned installations to spoil everything. Remember that your acceptance, and the future value of the program depend upon the excellence of your service.

• In selling SQC there are some special problems which should be mentioned.

There is first the natural resistance to change that may build up resentment against your suggestions. We do not like to change our way of doing things, and it may be that the very one to whom you are making your suggestions developed and installed the existing way of doing it. He may even consider it a personal affront that you dare to propose anything different. To overcome this difficulty it will be necessary to get the prospect to feel that he approved it, that he contributed part of it himself (or his staff) and that it is his proposal to go ahead.

You may be a relatively new man on the staff, and if so this can sometimes arouse resentment because you propose ideas when the more experienced heads feel they know more about how things should be run. Your attitude must be that you are no smarter than anyone else, but that you have a new tool which the others can use advantageously if they will. Encourage them to use your service and the new tool which it represents.

Some executives become embarrassed when they realize that they have an inadequate mathematical background, and they may actually object to the program in the fear that ultimately their lack of mathematics might be exposed and that they personally may be embarrassed if they support it. You must give assurance that they will not be required to have a math background above average, and that you or some qualified person will handle any mathematics as part of your service.

There may be misunderstanding among some who anticipate layoffs or that qualified men may lose their jobs as a result of the program. Good administrative procedures should cause no more difficulties from this cause than might be expected to result through the introduction of any other work improvement program. It should not be difficult to find places in the organization for good men if their present jobs can be accomplished with fewer man-hours.

• Let me leave a caution against the indiscriminate use of dice and cards to impress the uninitiated with the mysteries of probability. While you may be proud of your statistical prowess, you may not realize that there are some inividuals who will be adversely impressed by your actions. For example, some people violently oppose gambling in any form, and these will not hear what you are saying for their displeasure at your display of anything that they associate with gambling.

Yes, selling statistical quality control is just like selling anything else, and like anything else it must be sold to be successful.

# The Practical Calculation of Hotelling's T

THOMAS W. BAUER

*Abitibi Power and Paper Co., Ltd., Sault Ste. Marie, Ont.*

A recent paper by Hicks[1] on some practical applications and theoretical implications of Hotelling's T mentions that the actual calculation of $T^2$ for several variables becomes quite laborious unless special forms are devised for solving the higher order determinants whose ratio defines $T^2$.

A particularly convenient method for this case is the matrix method of Crout[2] which can usually be applied in solving multiple regression problems. As applied here it is not necessary to compute the explicit values of either of the determinants.

Crout's method of evaluating a determinant $|x_{ij}|$ consists of computing an auxiliary matrix $|X_{ij}|$ with the same number of elements. Each term of the auxiliary matrix is computed according to specific rules and may be obtained by a single machine calculation on the usual desk calculators. Instructions for these calculations are given in Crout's paper and are also available from the various calculating machine manufacturers[2]. They have been summarized and illustrated in the Mathematical Appendix. The value of the determinant is calculated from the auxiliary matrix as the product of the terms on its principal diagonal

$$X = (X_{11})(X_{22}) \ldots\ldots (X_{pp}).$$

Hotelling's T is defined in Hicks' notation[1] as

$$T^2 = - \frac{\begin{vmatrix} 0 & d_1 & d_2 & \ldots\ldots & d_p \\ d_1 & a_{11} & a_{12} & \ldots\ldots & a_{1p} \\ d_2 & a_{21} & a_{22} & \ldots\ldots & a_{2p} \\ . & . & . & & . \\ . & . & . & & . \\ . & . & . & & . \\ d_p & a_{p1} & a_{p2} & \ldots\ldots & a_{pp} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} & \ldots\ldots & a_{1p} \\ a_{21} & a_{22} & \ldots\ldots & a_{2p} \\ . & . & & . \\ . & . & & . \\ . & . & & . \\ a_{p1} & a_{p2} & \ldots\ldots & a_{pp} \end{vmatrix}}$$

Before applying Crout's method to evaluate the determinants the numerator may be rearranged to read

$$|x_{ij}| = -\begin{vmatrix} a_{11} & a_{12} & \cdots\cdots & a_{1p} & d_1 \\ a_{21} & a_{22} & \cdots\cdots & a_{2p} & d_2 \\ \cdot & \cdot & & \cdot & \cdot \\ \cdot & \cdot & & \cdot & \cdot \\ \cdot & \cdot & & \cdot & \cdot \\ a_{p1} & a_{p2} & \cdots\cdots & a_{pp} & d_p \\ d_1 & d_2 & \cdots\cdots & d_p & 0 \end{vmatrix} \tag{1}$$

which is obtained by an even number (2p) of interchanges of rows and columns of the determinant and, therefore, leaves its value unchanged.

When Crout's method is now used to calculate the value of the determinants it is seen that the terms of the determinant in the denominator are identical with the corresponding terms forming the upper left hand corner of the transformed numerator. The corresponding terms in the auxiliary matrices are also identical and, hence,

$$T^2 = \frac{-(X_{11})(X_{22})\cdots\cdots(X_{pp})(X_{p+1,p+1})}{(X_{11})(X_{22})\cdots\cdots(X_{pp})}$$

$$= -X_{p+1,p+1}.$$

It is, therefore, not necessary to calculate the actual values of the two determinants, but only the elements of the auxiliary matrix of the numerator (the last of which is the required term $X_{p+1,p+1}$). The derivation of the terms of the auxiliary matrix may be made self-checking by carrying an extra check-column as explained by Crout.

The method may be illustrated for the case p = 2 for the example quoted by Hicks on the chromium and manganese contents of M iron produced by two sucessive shifts. If the numerical values of the a's and d's are substituted in the transformed determinant of the numerator this becomes (with check-column)

$$|x_{ij}| = -\begin{vmatrix} 2224.6812 & 260.1332 & 42.8819 & 2527.6963 \\ 260.1332 & 78.3604 & -14.7251 & 323.7685 \\ 42.8819 & -14.7251 & 0 & 28.1568 \end{vmatrix} \tag{2}$$

and its auxiliary matrix is

$$|x_{ij}| = -\begin{vmatrix} 2224.6812 & 0.116931 & 0.019276 & 1.136206 \\ 260.1332 & 47.942881 & -0.411725 & 0.588275 \\ 42.8819 & -19.739304 & -8.953745 & 1.000000 \end{vmatrix} \tag{3}$$

and, hence, $T^2 = +8.954$ in agreement with the value given by Hicks.

Another example from the experience of this laboratory* is the evaluation of two types of resin in board manufacture. Board quality is judged by five factors:

Perpendicular Tensile Strength (p.s.i.)

Modulus of Rupture (p.s.i.)

Weight Increase on Water Immersion (%)

Swell on Water Immersion (%)

Permanent Deformation after Soaking and Drying (%).

The test results on 10 boards are summarized in Table I.

With the $a_{ij}$'s and $d_j$'s calculated from the data in Table I the transformed determinant in the numerator becomes (with an added check-column) that as shown in Determinant 4, and the auxiliary matrix with check-column is that in Determinant 5.

Hence, $T^2 = +91.342$, since $N_1 = 6$, $N_2 = 4$, $n = 8$, $p = 5$, and $F = \left(\frac{n-p+1}{np}\right)T^2$, with $n_1 = p$, $n_2 = n - p + 1$ degrees of freedom, we find

$$F = +9.134$$

with $n_1 = 5$ and $n_2 = 4$ degrees of freedom. This lies very close to the 2.5 percent significance level for F, and hence we may assume that the two types of resin give significantly different board properties. It may also be seen that resin II gives higher strength and better water resistance (lower values) and must, therefore, be preferred.

The simple correlation coefficients may be calculated with little further effort. (See Table II.)

The correlation between P.T.S. and M.O.R. is significant at the 5 percent level and the correlation between Swell and Permanent Deformation is significant at less than the 0.1 percent level. If the Swell of the two board types is different, the Permanent Deformation must also be different because the two variables are so closely related. If indeed we find it different, this fact adds far less to our knowledge of board quality than if an unrelated property such as the M.O.R. differs significantly. Hotelling's T takes the correlations between the variables into account and gives an exact test of significance for all factors simultaneously.

The rather heavy arithmetic involved in solving the higher order determinants may be simplified by a simple transformation of the determinant in the numerator of the ratio defining Hotelling's T, and then applying Crout's matrix method to solve the transformed determinant. Anyone familiar with this type of solution will readily appreciate that this method eliminates about half of the required computations.

## *Mathematical Appendix*

### The Evaluation of Determinants by Crout's Method

Given a matrix $||G_{ij}||$ which may be a determinant with or without an added check-column, the solution

**TABLE I—Test Results on Two Board Types**

| Resins | P.T.S. p.s.i. | M.O.R. p.s.i. | W.I. % | Sw. % | P.D. % |
|---|---|---|---|---|---|
| Type I | 68.0 | 3370 | 22 | 6.0 | 3.37 |
| | 78.6 | 3250 | 22 | 6.1 | 3.37 |
| | 78.0 | 3370 | 24 | 7.1 | 4.90 |
| | 57.5 | 3190 | 26 | 7.0 | 4.64 |
| | 43.7 | 2930 | 25 | 6.3 | 3.34 |
| | 49.5 | 2970 | 26 | 6.8 | 3.97 |
| Type II | 74.9 | 3210 | 20 | 5.0 | 2.12 |
| | 77.6 | 3730 | 19 | 4.7 | 2.20 |
| | 64.6 | 3500 | 20 | 5.2 | 3.14 |
| | 72.0 | 3690 | 24 | 4.6 | 2.21 |

**TABLE II—The Simple Correlation Coefficents $r_{ij}$**

| P.T.S. | M.O.R. | W.I. | Sw. | P.D. |
|---|---|---|---|---|
| 1 | 0.63528 | −0.54316 | −0.13936 | 0.041883 |
| | 1 | −0.22106 | −0.21033 | 0.17322 |
| | | 1 | 0.33919 | 0.25534 |
| | | | 1 | 0.90330 |
| | | | | 1 |

*Data supplied by Dr. M. F. Amos.

(4)

| | | | | | | |
|---|---|---|---|---|---|---|
| 146.420 | 1613.53 | −13.0594 | − 0.695938 | 0.316656 | − 15.0659 | 1731.45 |
| | 44084.4 | −92.1875 | −18.2188 | 22.7156 | −564.091 | 45064.1 |
| | | 3.94792 | 0.278125 | 0.316979 | 5.29308 | −85.4108 |
| | | | 0.170312 | 0.232906 | 2.59490 | −15.6384 |
| | | | | 0.390345 | 2.34574 | 26.3182 |
| | | | | | 0 | −550.923 |

(5)

| | | | | | | |
|---|---|---|---|---|---|---|
| 146.420 | 11.0199 | −0.0891910 | −0.00475301 | 0.00216265 | −0.102895 | 11.8252 |
| 1613.53 | 26303.5 | 0.00196647 | −0.000401073 | 0.000730934 | −0.0144493 | 0.987847 |
| −13.0594 | 51.7250 | 2.68143 | 0.0883110 | 0.114646 | 1.751579 | 2.95454 |
| −0.695938 | −10.5496 | 0.236799 | 0.141862 | 1.51538 | 13.7887 | 16.3041 |
| 0.316656 | 19.2261 | 0.307415 | 0.214974 | 0.0145951 | −58.0023 | −57.0022 |
| −15.0659 | −380.066 | 4.696723 | 1.95608 | −0.846550 | −91.3422 | 1.00000 |

consists of calculating an auxiliary matrix $||A_{ij}||$ with the same number of elements. The value of the determinant is given by the product of the terms on the principal diagonal of the auxiliary matrix

$$G = (A_{11})(A_{22}) \ldots\ldots (A_{nn}).$$

Let the given determinant be $|G|$ and add to it a check-column which is obtained by summing the rows of the determinant

$$G_{15} = G_{11} + G_{12} + \ldots + G_{14}$$

$$G_{25} = G_{21} + G_{22} + \ldots + G_{24}, \text{ etc.}$$

The given matrix is, therefore,

$$\begin{Vmatrix} G_{11} & G_{12} & G_{13} & G_{14} & G_{15} \\ G_{21} & G_{22} & G_{23} & G_{24} & G_{25} \\ G_{31} & G_{32} & G_{33} & G_{34} & G_{35} \\ G_{41} & G_{42} & G_{43} & G_{44} & G_{45} \end{Vmatrix}$$

The procedure for obtaining the auxiliary matrix is contained in the following rules:

(1) The elements of the auxiliary matrix are evaluated in the following order:

(a) the first column, (b) the remainder of the first row (the elements in the first row to the right of the first column), (c) the remainder of the second column (the elements below the first row), (d) the remainder of the second row (the elements to the right of the second column), (e) the remainder of the third column below the second row, (f) the remainder of the third row to the right of the third column; and so on until all elements have been determined, as indicated on the diagram of the auxiliary matrix.

| | | | | | |
|---|---|---|---|---|---|
| $A_{11}$ | $A_{12}$ | $A_{13}$ | $A_{14}$ | $A_{15}$ | Step 2 |
| $A_{21}$ | $A_{22}$ | $A_{23}$ | $A_{24}$ | $A_{25}$ | Step 4 |
| $A_{31}$ | $A_{32}$ | $A_{33}$ | $A_{34}$ | $A_{35}$ | Step 6 |
| $A_{41}$ | $A_{42}$ | $A_{43}$ | $A_{44}$ | $A_{45}$ | Step 8 |
| Step 1 | Step 3 | Step 5 | Step 7 | | |

(2) The first column of the auxiliary matrix is identical with the first column of the given matrix.

$$A_{11} = G_{11}$$
$$A_{21} = G_{21}$$
$$\vdots$$
$$A_{n1} = G_{n1}$$

The remainder of the first row is obtained by dividing the elements of the given matrix by the diagonal term of the auxiliary matrix.

$$A_{12} = G_{12}/A_{11}$$
$$A_{13} = G_{13}/A_{11}$$
$$\vdots$$
$$A_{1n} = G_{1n}/A_{11}$$

(3) Each element on or below the principal diagonal of the auxiliary matrix is equal to the corresponding element of the given determinant minus the product of the previously computed elements in its row and column of the auxiliary matrix. This yields for the second column

$$A_{22} = G_{22} - A_{21}A_{12}$$
$$A_{32} = G_{32} - A_{31}A_{12}$$
$$\vdots$$
$$A_{n2} = G_{n2} - A_{n1}A_{12}$$

(4) Each element to the right of the principal diagonal is given by the same rule but must be divided by the diagonal term of the auxiliary matrix. Hence, for the remainder of the second row

$$A_{23} = (G_{23} - A_{21}A_{13})/A_{22}$$
$$A_{24} = (G_{24} - A_{21}A_{14})/A_{22}$$
$$\vdots$$
$$A_{2n} = (G_{2n} - A_{21}A_{1n})/A_{22}$$

Applying rules (3) and (4) to the remaining terms in the order indicated by Rule (1), it is found that

$$A_{33} = G_{33} - A_{31}A_{13} - A_{32}A_{23}$$
$$A_{43} = G_{43} - A_{41}A_{13} - A_{42}A_{23}$$

.

.

$$A_{n3} = G_{n3} - A_{n1}A_{13} - A_{n2}A_{23},$$

$$A_{34} = (G_{34} - A_{31}A_{14} - A_{32}A_{24})/A_{33}$$
$$A_{35} = (G_{35} - A_{31}A_{15} - A_{32}A_{25})/A_{33}$$

.

.

$$A_{3n} = (G_{3n} - A_{31}A_{1n} - A_{32}A_{2n})/A_{33},$$

$$A_{44} = G_{44} - A_{41}A_{14} - A_{42}A_{24} - A_{43}A_{34}$$

.

.

$$A_{n4} = G_{n4} - A_{n1}A_{14} - A_{n2}A_{24} - A_{n4}A_{14},$$

$$A_{45} = (G_{45} - A_{41}A_{15} - A_{42}A_{25} - A_{43}A_{35})/A_{44}, \text{ etc.}$$

The scheme of the calculations will now be clear, showing how each term of the auxiliary matrix is obtained from the corresponding term of the given matrix and the previously computed elements.

The calculations may be checked at each stage according to the rule which states that the term in the check-column of the auxiliary matrix equals one plus the sum of the elements lying in the same row to the right of the principal diagonal.

$$A_{15} = 1 + A_{12} + A_{13} + A_{14}$$
$$A_{25} = 1 + A_{23} + A_{24}$$
$$A_{35} = 1 + A_{34}$$
$$A_{45} = 1$$

The rules and the algebraic formulas may be illustrated numerically by means of the previously quoted example on the chromium and manganese contents of M iron. The given matrix (the transformed determinant of the numerator with an added check-column) is

| | | | |
|---|---|---|---|
| 2224.6812 | 260.1332 | 42.8819 | 2527.6963 |
| 260.1332 | 78.3604 | −14.7251 | 323.7685 |
| 42.8819 | −14.7251 | 0 | 28.1568 |

The elements of the auxiliary matrix are now computed and the calculations are checked according to the rules outlined previously.

$A_{11} = 2224.6812$

$A_{21} = 260.1332$

$A_{31} = 42.8319$

$A_{12} = (260.1332)/(2224.6812) = 0.116931$

$A_{13} = (42.8819)/(2224.6812) = 0.019276$

$A_{14} = (2527.6963)/(2224.6812) = 1.136206$
$= 1 + 0.116931 + 0.019276$ (check).

$A_{22} = 78.3604 - (260.1332)(0.116931) = 47.942881$

$A_{32} = -14.7251 - (42.8819)(0.116931) = -19.739304$

$$A_{23} = \frac{-14.7251 - (260.1332)(0.019276)}{47.942881} = -0.411725$$

$$A_{24} = \frac{323.7685 - (260.1332)(1.136206)}{47.942881}$$
$$= 0.588275 = 1 - 0.411725 \text{ (check)},$$

$A_{33} = 0 - (42.8819)(0.019276)$
$- (-19.739304)(-0.411725) = -8.953745$

$A_{34} = 28.1568 - (42.8819)(1.136206)$
$- (-19.739304)(0.588275)/-8.953745$
$= 1.00000$ (check).

A special simplification of the calculations is possible if as in the present case, the determinant is symmetrical about the principal diagonal. The terms to the right of the diagonal may then be obtained more simply by dividing the symmetrically opposite element by the diagonal term. In the present instance the term $A_{23}$ might have been calculated more simply

$$A_{23} = A_{32}/A_{22} = \frac{(-19.739304)}{(47.942881)} = -0.411725$$

in agreement with the previously found value.

For the proofs of these relations (which require a fair knowledge of matrix algebra) and for further applications of this method to the solution of simultaneous equations Crout's original paper should be consulted[2].

### *References*


(1) Hicks, C. H., "Some Applications of Hotelling's T," *Industrial Quality Control*, Vol. XI, No. 9, June 1955, p. 23

(2) Crout, P. D., "A Short Method for Evaluating Determinants and Solving Systems of Linear Equations with Real or Complex Coefficients," *Transactions of the American Institute of Electrical Engineers, 60*, 1941, p. 1

Also reprinted and distributed with detailed instructions by the Friden, Marchant, and Monroe Calculating Machine Companies.



**REVISED ENGINEERING VOCABULARY**

**It's in process:** So wrapped up in red tape that the situation is almost hopeless.

**We'll look into it:** By the time the wheels make a full turn, we assume you will have forgotten about it, too.

**A program:** Any assignment that can't be completed by one telephone call.

**Expediter:** One who confounds confusion with commotion.

**Channels:** The trail left by inter-office memos.

**Coordinator:** The guy who has a desk between two expediters.

**To activate:** To make carbons and add more names to the memo.

**To implement a program:** Hire more people and expand the office.

**Under consideration:** Never heard of it.

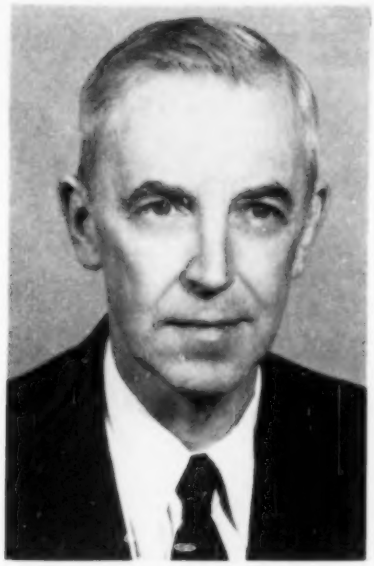
**Under active consideration:** We're looking in the files for it.

**A conference:** A place where conversation is substituted for the dreariness of labor and the loneliness of thought.

# Dimensions of Diversity

MASON E. WESCOTT

*Rutgers University, New Brunswick, N. J.*



***The 1956 Shewhart Medalist***
***Mason E. Wescott***

Mr. President, Professor Olds, friends and colleagues in ASQC:

It would be so much more satisfying were it possible for me to find words that *could* convey to you the mixed, but not contradictory, emotions of sincere humility and bursting pride with which I stand before you on this occasion. That this Society should have chosen to include me in the distinguished company of those who share this unique honor is ample justification for the confidence and support so generously given me by so many on whose shoulders I have stood over the past ten years. I am proud to accept this recognition, not only for myself, but for them also, for no man ever owed more to his friends than I do.

It probably will not surprise you to be told that of all the topics on which I could have chosen to address you tonight, I have selected the one that is closest to my experience and affection—our Society's publication activity and, in particular, its journal, *Industrial Quality Control*.

### A Parable

Let me begin by reporting to you a parable I once came across from a source I have now lost track of.

In the ancient days of the distant past there once was a king who decreed that a royal highway be built in a perfectly straight line from his palace to the seashore many miles away. It so happened that the route such a road would have to follow ran directly athwart a huge boulder. Since this was in the days before the existence of anything resembling our modern equipment for disposing of such an obstacle, the problem of laying out the highway according to the king's orders posed a real dilemma.

Unable to find any means for moving the boulder out of the path of the king's highway, his construction engineers were in grave distress and utterly at their wits end. They were about to petition the king for a relaxation in the specifications when a humble peasant appeared who assured them that in three days he could dispose of the boulder with only the simplest of tools. Moreover, his terms for this service were extremely modest, so he was at once commissioned to have a try at it.

He gathered together a crew of fellow peasants who first busied themselves with securely propping up one side of the boulder. This done, they simply set to work to dig a hole big enough to contain the boulder, knocked out the props, and let the boulder topple into its grave where it remained safely buried beneath the highway the king wanted.

### Comments

There are several rather pointed morals that one can draw from this little parable, but I sense two that appear to be particularly worthy of mention:

(1) The "experts" do not always have the answer. Conditioned by tradition and experience to attack problems along routine channels, imagination and resourcefulness sometimes become dulled to a point where ingenuity is no longer able to rise to the occasion. A fresh viewpoint, uninhibited by too much familiarity with the "Why-this-is-the-way - we've always-done-it" attitude is often needed and may frequently be found in humble and unsuspected sources.

(2) It pays to think in three dimensions. If we can't pull or push or dissemble the obstacles that block our progress by the familiar strategies of horizontal thinking, try thinking vertically. It may not be easy, but it can be very rewarding.

I suspect that a pretty good paper could be built around the implications of the first of these two morals as they apply to the field of SQC. At the very least, we have to concede that the Shewhart control chart philosophy breeds a totally fresh point of view toward inspection, production, engineering, and even research and development problems that puts within reach of the common man a new and effective versatility for understanding and attacking the defense-in-depth warfare that variation wages all along the industrial front.

However, it is the second of these two morals which I propose to expand here. I invite you to think with me for a few moments about some aspects of the publication activities within ASQC, and especially its journal, *Industrial Quality Control*. We shall need to think in several dimensions about this general subject—three will not suffice. Let me christen this discussion "Dimensions of Diversity."

### Historical Review

First of all, when a professional society is organized to serve a new area of technical or scientific interest, there arises at once the necessity for creating an adequate medium

to provide for the communication of ideas within this community and to document the character and objectives of the society that will entitle it to recognition and influence in the company of other existing technical and scientific groups. This has been the pattern in the history of every professional society today recognized as such, including the American Society for Quality Control.

We were exceptionally fortunate at the time ASQC was founded in February, 1946, to be able to inherit an existing publication already flourishing under the able editorship of Martin Brumbaugh. There is no doubt in my mind that the existence and availability at that time of *Industrial Quality Control* as the official journal of ASQC was very nearly, if not indeed, the dominating factor that succeeded in welding together as a single national society the diversity of interests that needed the inspiration of a focal point about which they could join hands in a common cause.

Consider for a moment the sporadic and fragmentary nature of the literature in the field of SQC as of 1945-46. There are those in this audience who will well remember how difficult it was to find published material on quality control by statistical methods in the early 1940's. There were a few, now famous books, such as Shewart's *Economic Control of Quality of Manufactured Product*, the Dodge and Romig *Sampling Inspection Tables*, Simon's *Engineers' Manual of Statistical Methods*, Freeman's *Industrial Statistics*, the ASTM *Manual on Presentation of Data*, and the American Standards Association War Standard Z-Manuals, but, in this country at least, papers in this field were relatively few and far between and generally difficult to acquire.

Indeed, in 1945, it was possible to put together, as one of the 12 Quality Control Reports sponsored by the War Production Board, a bibliography of quality control titles which, in its day, was a quite comprehensive record of what could be found in the literature of this field. Today such an undertaking would stagger the imagination and tax the resources of any agency that committed itself to such a project.

If I may be permitted to indulge a speculation, I will hazard the guess that few professional technical societies can boast a membership with more avid readers than we have in ASQC. Throughout the history of this society to date we have had an almost insatiable hunger in our ranks for readable material in our field at all levels of sophistication. This is a healthy sign, and a fact in which we can take justifiable pride. It is also a challenge for which we must exercise sober concern, for if the stimulus and capacity to learn ever ceases among us, or is not nurtured with imagination by the agencies within our society to which our members look for guidance and inspiration, we shall at that point cease to be a dynamic society and begin to slip into the fatal inertia of complacency.

Returning now to the main theme, we had at the end of World War II the spectacle of a virtual vacuum existing on the industrial scene in the field of quality control by statistical methods. The American Society for Quality Control with its journal, *Industrial Quality Control*, stepped in to fill this vacuum, to integrate and give direction to the slender heritage of experience spawned under the pressures and disruptions of the war effort in industry, and to create and develop and give dimensions to a totally new technical and scientific profession. Modern scientific quality control as a profession now had a corporate body in which to live and a voice to make its needs known and its influence felt.

It is not my intention to recount for you the sometimes devious, sometimes brilliant, but always determined ways in which the Society has overcome the often impetuous awkwardness of youthful immaturity, rolled with the punch on many an occasion, and found its way to the stature and standing it enjoys today. Let me say simply, in passing, that, as a professional technical society, I believe we are just now beginning to be equal to our opportunities—equal in experience, in manpower, in resources, in organizational structure, in long-range vision.

### Significance of ASQC Publications

What I do want to emphasize, rather, is the very significant function which our journal and auxiliary publications play in molding the professional character of the Society and in promoting—*or* retarding!—recognition and acceptance of ASQC as a bona fide member of the family of professional societies serving the technical needs of the world in which we live.

Although we can correctly claim for an individual person that what he *does* speaks louder than what he *says*, something approximating the converse of this holds true when it comes to judging the scientific integrity of a professional society, such as ours. For, like it or not, publications bearing the insignia of ASQC—the voice of our society, if you please—not only influence in pretty direct ways what we individually and collectively *do* in practicing the science of modern quality control, but equally important, they are the mark by which the rest of the scientific community pretty largely judges our professional worth as a society. This is not a point of view that requires any defense—it is a flat statement, which, coming from one supposed to be committed to the concept of risks rather than categorical assertions, may be somewhat surprising.

### The Challenge of Diversity

The implications of this assertion are many and far reaching. They add up to a challenge which it will be our concern to explore in what follows.

The challenge that faces our journal and auxiliary publications has been, and is, unique. This uniqueness stems from the fact that no other professional society of which I know spans such a broad spectrum of technical activity and interests as that which ASQC seeks to serve. Other professional journals are directed toward serving either a specific area of *activity* or a specific field of *interest*.

For example, *Industrial and Engineering Chemistry* has a clearly defined area of *activity* to serve. It is free to cover a broad range of technical material—and does—in serving this area, but the area of activities itself is recognizably homogenous in composition. *The Journal of the American Statistical Association*, on the other hand, cuts across broad strata from industry, economics, engineering, government, social research, and others, but across this spectrum of activity it is serving exclusively the field of *statistical interests*. Other equally good examples could be cited, but these two serve to establish the point I am trying to make.

Now consider the charge which the very character of the membership of ASQC hands over to our journal and auxiliary publications. We are asked to serve the publication needs of the quality control function in every major area of industrial *activity* in our economy, and within and across these strata, to serve the publication needs of the

quality control function from the angle of almost every field of technical *interest* you can name!

The automotive industry, the chemical industry, the textile industry, the electronic industries, the mechanical industries, the steel industry—right on down the list—have a stake in ASQC in terms of their own special needs which they have a right to expect will be served by material we publish in the interests of modern quality control. Within these various areas of *activity* we have *interests* that range all the way from inspection and testing routines right on through production, engineering, research and development, specifications, purchasing, personnel, inventory, accounting and clerical operations, sales, forecasting, vendor-vendee relations, to the decision making responsibilities of top management itself.

The quality control function touches all these fields of interest in all the several areas of industrial activity, and all combinations of activities and interests exist in the audience our Society publications are asked to serve. In addition, there are still other groups, such as academic personnel and professional engineering, statistical, and technical people, both in and out of government positions, that are numbered among the audience looking to the literature of our Society for material of interest to them.

This is a truly immense challenge—one that can be met only by a publication program structured in dimensions of diversity. However, we must be careful here, for a program based on a concept of diversity invites a real risk—the risk of making the unwarranted inference that our publication effort should be directed along lines that attempt all things for all people. Such a program, if pursued to its ultimate, can only result in spreading our publication effort so thinly that surface tension disappears and we come to mean nothing to anyone through what we print.

The challenge our society faces in administering its publication effort calls for a program based on *planned* diversity—diversity with a purpose—not just diversity for the sake of novelty, or convenience, or popularity—not diversity that partakes of confusion or aimlessness, but *directed* diversity.

Such a program is neither easy to formulate nor to activate.

### *Dimensions of Directed Diversity*

What are some of the possible dimensions of a publication program committed to a policy of directed diversity?

It seems to me we should begin by thinking of the reader as the dependent variable. We can conceive of him as existing at all points of some idealized response surface. We seek a coordinate system that will provide a function in the form of a publication program which "fits" this idealized response surface of readers under some operationally meaningful criterion for goodness of fit. We should like to have a standard error of estimate that would be constant at all points of this fitted surface, but this is probably too much to hope for!

If we take our coordinate axes for the input variables to be those of areas of *activity* and/or fields of *interest* within the existing industrial universe we shall almost certainly experience frustration in trying to derive a publication function that fits this reader response surface in any continuous way. These are *parameters* of a publication function—not its fundamental independent variables.

Let me suggest five basic dimensions—input or independent variables—coordinate axes, if you prefer, —that will serve as a reference frame on which we may construct a publication program that *can* meet the unique challenge it faces.

#### *1. Nurturing Professional Concepts of Quality Control*

First, I would name the development, exposition, promotion, and continuing maintenance of a broad, modern, truly professional concept of the quality control function in industrial operation and management. There simply *is* no more imperative or urgent factor to which our society can give its attention. We have been playing this theme song pretty much by ear over the last ten years. Out of it all there are beginning to emerge some concrete outlines of what A. V. Feigenbaum in a paper in this month's (May 1957) issue of *Industrial Quality Control* aptly calls "total quality control." If the American Society for Quality Control is ever to become a truly *professional* society, it must rest its claim for recognition on this distinction. Moreover, it is squarely up to us as a society to formulate, to promote, and to maintain the characteristics that will distinguish *quality control* as a truly technical profession.

We have given this major issue some attention in papers we have published. We must give it more attention. It is a dynamic issue which I anticipate never can or will be frozen into a solid state. It is a fundamental dimension of any publication program designed to serve the best interests of our society.

#### *2. Continuing Emphasis on the Concepts of SQC*

Secondly, I would name continuing emphasis on the concepts of *statistical* quality control. I am not here thinking in terms of area of industrial *activity*, nor even in terms of field of *interest*—I am thinking in terms of *concepts*. Like it or not, the fact still remains that you simply cannot have quality control in the modern, scientific sense *without* an informed and active and integrated use of the science of statistics as a vital part of the quality control function. The *concepts* of statistical science generate a pattern of thinking and lead to a system of strategies that together provide the most effective discipline man has yet devised to help him understand—and therefore to *control*—the phenomena of variation.

It cannot be denied that this component of our publication program has dominated ASQC literature thus far. Although I do not believe this fact represents a necessarily *intentional* policy on the part of your Editorial Board, I do submit that it has been a wise policy. It has literally lifted large segments of our membership by their boot straps!. It has brought—and held to our society—strength we could not well do without. Most important of all, it is, *as of now*, very nearly the *only* substantial claim we have as a society to *professional* stature.

## SCHEDULE OF MEETINGS 1957-58

### Operating-Executive Committee

1957

July 26, Cincinnati, Ohio
Sept. 20, New York, N. Y.
Nov. 15, Milwaukee, Wis.
Nov. 15, Milwaukee, Wis. (Board of Directors)

1958

Feb. 7, Chicago, Ill.
Apr. 11, Detroit, Mich.

*Items for the agenda for any meeting should be in the hands of Executive Secretary two weeks before the date of the meeting.*

I say with complete candor that as a society we shall fall *far* short of the full potential we could achieve if we continue to give the appearance of being nothing more than another *statistical* society! With equal candor I say in all seriousness that our greatest achievement as a society to date resides in a publication practice that has put the emphasis on translating statistical *theory* into successful industrial *applications*. We have, through ASQC publications, earned recognized and commendable success as an *interpreter* of statistical theory. We have not been trying to make statisticians out of industrial personnel: we have simply been trying to help them toward greater effectiveness in their respective responsibilities by encouraging them to acquire a clearer insight into the concepts of statistical science.

This is a second fundamental and indispensable and continuing dimension of an adequate publication program for ASQC.

#### 3. Encouragement of Creative Research

The third dimension I would name is orthogonal to both of the first two I have discussed. As a professional society, our publication program must provide an outlet for creative research. I put no restrictions on this, save that the research be legitimate, competent, and directed toward some specific facet of the quality control function. Creative research in pure mathematical statistics already has a home—several homes, in fact! Our literature should not be asked nor expected to provide space for such papers. Indeed, we have, on several occasions, already rejected perfectly good contributions of this character.

On the other hand, applied statistics, especially as it concerns the concepts of statistical quality control, has large and important areas still unploughed in terms of creative research. Some of this work has already found its way into our society literature and more will come. We cannot pose as a *professional* society serving the quality control function if we neglect or discourage activity in this fundamental dimension of publication policy.

But *statistical* quality control is only one face of the *total* quality control concept. There is very real and pressing need for creative research in other vital—shall we say "*non*-statistical"?—elements of the quality control function. Distressingly little of this sort of creative research has as yet come to light in the official publications of ASQC. We cannot take time to enlarge on what I believe to be explanations for this dearth. Suffice to say that creative research of this character needs attention and encouragement, and, when it represents a constructive contribution, the publication facilities of this society should be the preferred medium to serve as an outlet for it.

So a third fundamental dimension of our publication program must be the axis that provides a range of variation for creative research directed toward enriching and strengthening various phases of the quality control function in industry.

#### 4. Reporting Case History Studies

A fourth dimension I would name may be called the "case history" dimension. This is probably a pretty badly shop-worn phrase but it describes quite accurately what I have in mind. When we consider the present size and future growth in ASQC membership—not to mention the amazing diversity in the character and composition of this membership—it is perfectly clear that large segments of this reader response surface we are seeking to probe can only be reached in any satisfying way by working along this case history axis of our publication program.

Your Editorial Board never has—and I trust never will—look down its nose at good case history contributions. There is nothing quite so certain to trigger the imagination or stimulate confidence or encourage renewed effort as a good case history that tells how the other fellow found his way out of the same jungle of confusion and uncertainty in which you yourself feel lost. But it has to be a *good* case history contribution—one that describes a real problem clearly, outlines the strategy and supplies the essential details that led to a solution, and presents an integrated story that keeps to the facts without unnecessary window-dressing.

We have to be firm in saying "No" to rambling contributions of lesser merit because the professional integrity of ASQC is at stake. But if there is a disposition on the part of anyone, either in or out of ASQC, to assert that the publication of *good* case history papers places the professional integrity of the society in jeopardy, I take emphatic exception to such an assertion. If I may judge from past experience on this point, I would say that your Editorial Board is perfectly willing to take the responsibility for creating, if necessary, a new standard of professional integrity in terms of good case history contributions with a real message well presented.

At any rate, if we are to hold our membership and broaden its base, we cannot exclude from our publication function this vital dimension of case history documentation.

#### 5. Providing Information Service

Finally, I would name as a fifth dimension what I shall call simply the straightforward information service axis. This has little to do with our professional stature as a society, but it has a lot to do with keeping the ASQC family together and keeping it informed. It includes such things as our various departmental material in *Industrial Quality Control*, our official ASQC Standards publications, the respective Divisional News Letters, and, of course, our advertising.

Let me say a word about this last item. Advertising is a critical point on this information service axis. With respect to this critical point each of us, as an individual, is either

## CHEMICAL DIVISION NEWS

The spring council meeting was held during the Annual Convention in Detroit. All councilors were present with the exception of those from the distant points of California and Canada.

The annual meeting of the division was also held during the Convention and was preceded by a dinner which was attended by 63 persons. At the annual meeting in 1956, a 34 percent membership growth was reported; this year the figure was 35 percent.

Close to 60 percent of the membership cast ballots in the annual election of officers and councilors, including two members separated by great distance, but close in spirit at least—Prof. Kaoru Ishikawa of Tokyo University and Mr. Takeo Fujita of the Sumitomo Chemical Co. in Knohana, Japan.

Elected were Maynard Renner, chairman; Paul Leatherman, chairman-elect; Vic Shelburne, secretary; and Otto Kral, treasurer. Councilors elected were Maurice Blew (1), Norman Hodge (2), Harold Davidson (3), Vance Ward (4), Mack Truax (5), Emil Wiest (6), George Scott, (7) Ben Carpenter (8), Ed Schultz (10), "Cort" Cortelyou (11), Grove Bellile (12), Herbert Bock (13), Jerry Moyer (14), Walter Adams (15), and Ed Elkins (16).

on the "accept" or the "reject" side of it. Advertisers are not altogether altruistic. They need some assurance that the information service they are paying *us* to use is *being used!* Cultivate the habit of looking at the ads our journal carries. You will be pleasantly surprised to find how high the rate of return in interest and information can be to you per unit of your time invested in this way. If there is any way you can contribute a positive response to any one of the ads you see, don't "let Bill do it"—do it yourself!

We need more pages in IQC to do the publication job that is ahead of us. We can afford to increase the size of our journal only if we have adequate advertising support. We can encourage advertising support only if we support our advertisers. We can support our advertisers only if we respond to them in some tangible way. If this be a syllogism, make the most of it!

So the fifth dimension in a set of coordinate axes for deriving a diversified publication function is the information service axis, including advertising. We cannot ignore this dimension, neglect it, or take it for granted if we expect to obtain a publications response surface that fits in any meaningful way the reader audience universe we want to reach.

### Recapitulation

These, then, are five fundamental coordinate axes along which there range the basic variables of a publication program that can come to grips with the challenge thrown at it by the unique character of ASQC as a professional society. They may not be mutually orthogonal dimensions in the sense of being mutually exclusive. Almost certainly they do not constitute an exhaustive system in the sense that no further axes can be added to the system. But they do provide at least a fundamental, minimum framework within which we can operate.

These are dimensions of diversity, the diversity inhering in the way our contributors, our Editorial Board, and those responsible for the technical and editorial content of our auxiliary publications work along these axes to explore various regions of the total reader response surface so as to specialize appropriately in these regions the parameters of area of industrial activity and field of special interest.

### The Educational Objective

The constant term in this publications "regression" function analogy is definitely identifiable as education. This is what a truly professional technical society is all about anyway—it is its very *raison d'être*. The higher we can push this intercept of education above the origin on the axis of the dependent reader variable, the stronger our society will be professionally and every other way. The literature of ASQC is its major instrument for serving this paramount objective. The agencies of the Society responsible in any way for what is published under the insignia of the Society must exercise that responsibility faithfully to insure that our publication effort is kept constantly on the target of stimulating and satisfying man's instinctive urge to experience the subtle alchemy of education. To become careless or indifferent or even casual about this matter of keeping the educational objective constantly before us in every channel of our publication outlet is to invite degradation in the very purpose for which we are organized. This is not the sole responsibility of the Editorial Board—what is needed here is the collective will *of* the Society itself constantly exerted to maintain the best traditions of an educational standard *for* the Society.

### ASQC Publication Media

The vehicles for carrying this publication burden for the Society are, of course, its official journal and its allied General Publications series, and all the auxiliary publications issued in the name of ASQC by its conventions and its regional, divisional, and section conferences. We have developed identifiable patterns in all this activity, some of which are good, some of which are questionable.

We cannot here accommodate a full exploration of the nature or implications of these various patterns. Suffice to say that there is room for improvement and that with patience and cooperation, definite improvement is possible. There is no dearth of material, nor should there be. The problem is simply one of better coordination in both the mechanics of preparing and issuing these various publications and in better—or at least *closer*—supervision of the editorial content of what goes into them. We must be careful not to stifle initiative and enthusiasm for the sheer sake of coordination, but we do need a *modus operandi* for managing these auxiliary publications of ASQC that will bring the total Society publication program into better perspective and sharper focus.

With respect to our journal and its General Publication series, I would like to hope that the time may soon come when this auxiliary series can be expanded and merged into a separate publication as a regular Supplement to *Industrial Quality Control* issued, say quarterly, and on a straight subscription basis rather than as a privilege of membership.

## ELECTRONICS DIVISION

The elected officers for the year were announced at the second annual meeting of the Electronics Division which was held in Detroit. They are: chairman—I. W. Schoeninger, Centralab, Milwaukee, Wis.; vice chairman—H. A. Schumer, International Resistance Co., Philadelphia, Pa.; secretary—G. H. Beckhart, Radio Corporation of America, Camden, N. J.; treasurer—D. Voetglen, Radio Corporation of America, Rome, N. Y. Elected as district councilors were: District 1—B. Goldsmith, Raytheon, Newton, Mass.; District 2—G. Endrich, General Electric, Syracuse, N. Y.; District 3—E. Hahne, Sperry Gyroscope, Great Neck, Long Island; District 4—J. B. Pringle, Bell Telephone, Montreal, Canada; District 5—M. J. Mozenter, Teledynamics, Philadelphia, Pa.; District 6—J. Tennisson, Civil Aeronautics Admin., Washington 25, D.C.; District 8—J. Bernesderfer, General Electric, Cincinnati, Ohio; District 11—R. Haertel, Stewart Warner Corp., Chicago, Ill.; District 12—R. Carlson, Remington Rand, St. Paul, Minn.; District 16—J. H. Yueh, Lockheed Missile Systems, Sunnyvale, Calif.

Ellis Ott, Division Trustee, addressed the meeting on the desirability of closer liaison with local sections and the need for speakers and publications in the electronics field.

Gus Mundel reviewed the past year's accomplishments before presenting the Division Charter to Irving Schoeninger. This coming year, we plan to provide speakers for several regional conferences as well as co-sponsoring the 4th National Reliability Conference. In addition, copies of the transactions of the 3rd National Reliability Conference are to be distributed to members of the Division.

To assist the Divisional activities all members were asked to send outlines of papers to G. H. Beckhart so he can assist the various program chairmen and enlarge the Division speakers list which is sent to all sections.

This is one way to encourage creative research work on behalf of the concepts and practice of modern, scientific quality control and to provide a feasible, professional outlet for it. There are other fairly obvious advantages that would accrue to both IQC and the Society itself through such a step. Let me urge that we begin thinking seriously and soon in this direction, and that resources be uncovered to support such an expansion in our publications program.

### *Summary and Conclusion*

It has been my intention in what has been said to try to direct your thinking with me about some of the background, some of the environment, some of the purposes, and some of the possibilities that surround and pervade the great task to which ASQC is committed through its publications in fulfilling its role as *the* professional technical society founded and dedicated to "create, promote, and stimulate interest in the advancement and diffusion of knowledge of the science of quality control and of its application to industrial processes." There is the risk that in this presentation I may have conveyed an impression of presumption on my part.

Let me deny any such motive. It has simply been my good fortune and privilege to be more or less at the center of the Society's publication effort, and from that vantage point I have tried to share with you briefly some outlines of the Society's publication picture as I see it. No man is more conscious than I am of the fact that such success as we have achieved and such progress as we shall make in meeting the challenge that lies before us is the fruit of the labor of many hands and many minds working together in a common effort to strengthen our Society and serve its needs. I am keenly conscious of the magnitude of the assignment this Society has entrusted to me, but I am equally conscious of the extent to which this assignment depends on a whole host of unsung heroes without whose willing service our entire publication program would grind to a jarring halt.

There is a little motto which has captured my attention and which many of you may also have seen. It says "The plains of mediocrity are white with the bones of countless thousands who, at the dawn of success, sat down to rest—and resting, died!"

Whether we are at the dawn of success in our publication program is indeed debatable, but we are certainly not at the brink of failure either! What lies ahead for us is almost breath-taking in its possibilities. Let us *together* go forward to meet this challenge with ever increasing effectiveness. I pledge that from wherever I stand with you in this effort there shall be no sitting down to rest!

# SUPERVISOR'S CIRCLE

**PAUL A. ROBERT, *Editor***

*Gruen Watch Company, Time Hill, Cincinnati 6, Ohio*

## DIAGNOSIS FOR A COMMON GAGE AILMENT

**A Practical Method for Determining the Lack of Repeatability of Gages**

**LEON BASS, *Jet Engine Dept., General Electric Co., Evendale, Ohio***

One day not so long ago a production expediter who had passed on to the great beyond was explaining to the head man of the lower regions how he had always managed to meet his parts production schedules when he was back on earth. "Nothing to it," he was heard to say. "The secret was never to scrap a part. I just sent it back for reinspection and some inspector would always pass it the second or third time."

This is a sad but true commentary on the state of affairs in many of the best regulated American factories. In the past we have been concerned about this situation occurring in our plant, but any dangers in this area have been virtually eliminated.

What are the causes of this seeming dissension in the ranks, this lack of precision in an area where precision is vital? True, it could be caused by poor training or lack of standardization of the inspectors in the specific quality objective or the method of inspection. Possibly some extraneous factor or uncontrolled variables such as time, temperature, pressure, or voltage, to mention a few, might be the source of the difficulty. However, in a properly directed organization, the training of inspectors and communication between them is a fundamental issue. The isolation and correction of the particular extraneous factor that might be the cause of variability in inspection or test results may present something more of a problem. However, familiarity with the subject will generally allow a rapid solution to this problem. In any event, methods of correlation or experimental design and analysis of variance can be used to find the culprit, or at least to establish the likelihood that none exists.

What, then, is the major source of difficulty? We have found it to be built into the gage, test equipment or inspection method that is used. It is astounding that in general so little attention has been paid to such a basic thing. Most quality control organizations see to it that their gages pass through a tool and gage inspection which insures that the gage meets the tool drawings. They have

cyclic or periodic reviews or adjustments of the gage to see that it stays at the original level. Instruments and test sets are checked and calibrated periodically to assure their accuracy. But what about the precision of these devices (or lack of it)? Is there a noticeable difference between succesive readings? Is there a difference between readings obtained by different operators on the same gage or instrument? Is there any interaction between certain parts and the operators? (That is, do parts with particular characteristics exhibit more variability of reading between operators than others?)

We found the answers to most of these questions to be definitely yes. To solve the problem, Jack Gantt, Supervisor of our Quality Engineering Unit, has developed a simple statistical test (based on $\overline{R}$ estimate of population variability) which can be performed by any group of inspectors. This test merely determines a value of "lack of repeatability" of any gage or other measuring device, and compares this to the tolerance allowed on the item under test. If the measuring device has too much variability, it should not be used until it has been corrected. The test also provides a method for determining operator difference. Both methods are based on 99 percent ($2.575\sigma$) limits. We have set our limit of maximum gage unreliability at 10 percent of the part tolerance. The operator difference is pegged at a maximum of 4 percent of the part tolerance. For simplified data form and instructions see Fig. 1. We also use the same technique in controlling between gage variability. For example, three gages are procured to inspect a part. Two are sent to vendors' plants. One is retained to check incoming parts. The method shown in Fig. 2 will give a factual estimate of the difference between gages and will provide data for gage part interaction, if this is important. This allows corrections to the gages to be made so that any disagreement between them is compatible with the tolerances of the parts involved.

You may wish to vary these percentages to suit your own needs. However, the use of this system will improve the reputation of your inspection department, and will certainly allow you to accept or reject parts on a much more realistic basis.

GAGE REPEATABILITY TESTS

Tool (Gage) # _____ Vendor _____
Part # _____ Order # _____
Dimension _____ Dwg. Zone _____
Dwg. Tolerance _____ Insp. Operator "A" _____
Planner _____ Insp. Operator "B" _____
Insp. Foreman _____ Insp. Operator "C" _____

BLOCK A

| Column # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Part Dev. # | Operator A | | | Operator B | | | Operator C | | |
| | 1st Rdg. | 2nd Rdg. | Rg Diff. | 1st Rdg. | 2nd Rdg. | Rg Diff. | 1st Rdg. | 2nd Rdg. | Rg Diff. |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| Column Totals | | | | | | | | | |
| Averages | | | | | | | | | |
| | | Sum | | | Sum | | | Sum | |
| Divide by 2 | $\overline{X}_A$ | | | $\overline{X}_B$ | | | $\overline{X}_C$ | | |

BLOCK B

| | | |
|---|---|---|
| $\overline{R}_A$ (Col. 3 avg.) | $\overline{X}_A$ | $\overline{X}_A$ $\overline{X}_B$ |
| $\overline{R}_B$ (Col. 6 avg.) | $\overline{X}_B$ | $\overline{X}_C$ $\overline{X}_C$ |
| $\overline{R}_C$ (Col. 9 avg.) | $\overline{X}$ Diff. | |
| Sum | Max. $\overline{X}$ Diff. ____ x 100 = ____ | % Operator Diff. |
| Divide by 3 = $\overline{R}$ Average | Dwg. Tolerance Spread ____ | |

BLOCK C

$\overline{R}$ _____ x 3.269 = _____ Limit of individual R's. Circle those that are beyond this limit. Correct $\overline{R}$ by recalculating, leaving out those circled points.

BLOCK D

$\overline{R}$ (recalculated) _____ x 4.566 = _____ (99% repeatability total spread)

Repeatability _____ x 100 / Drawing Tolerance Spread _____ = _____ % Repeatability

Figure 1

## Gantt Gage Repeatability Tests—Variable Gages *Only*

Use 3 operators (usually 3 who will be using the gage) and 10 parts.

## COMMENTS OF THE EDITOR

*As the author points out, many of the disagreements between process and final inspection, between a contractor and his vendor, between the contractor and government inspection is to be found in the lack of repeatability of gages and measuring instruments.*

*At the Evendale Plant of General Electric they have developed a simple procedure for estimating the error due to the difference in individuals and that due to the lack of repeatability in the gages.*

*Just as those unfamiliar with inspection are usually amazed to find that 100 percent inspection is not 100 percent effective, it is always surprising to them to find that common measuring instruments graduated in 0.001ths often are capable of repeating within one graduation and that even greater variance is attributable to the "feel" of the person using the instrument.*

### *Correction Notice*

The following correction applies to "Average Sample Number Under Curtailed or Truncated Sampling" by I. W. Burr, which appeared in Vol. XIII, No. 8, Feb. 1957, page 5. Attention has been called to the fact that the author's formula (10) appears essentially as formula (38), P. 212, in *Sampling Inspection*, Statistical Research Group, McGraw-Hill, 1948. Hence any priority implied in the article should be deleted.

GAGE COMPARISON TESTS

Part # _____

Dimension _____ Dwg. Zone _____

Dwg. Tolerance _____

Planner _____ Foreman _____ Operator _____

| | A | | | B | | |
|---|---|---|---|---|---|---|
| | Gage # | | | Gage # | | |
| | Vendor | | | Vendor | | |
| | Order # | | | Order # | | |
| Col. # / Part Serial # | 1 1st Test | 2 2nd Test | 3 $R_A$ Diff. | 4 1st Test | 5 2nd Test | 6 $R_B$ Diff. |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| Column Totals | | | | | | |
| Average | | | | | | |
| | | Sum | | | Sum | |
| Divide by 2 | | $\bar{X}_A$ | | | $\bar{X}_B$ | |

| | |
|---|---|
| $\bar{X}_A$ (Col. 1 avg.) | |
| $\bar{X}_B$ (Col. 4 avg.) | |
| Sum | |
| Divide by 2 / $\bar{X}$ Average | |

$\bar{R}$ _____ x 3.268 = _____ Limit of Individual R's. Circle those that are beyond this limit. Leave out the test values associated with the circled R's when calculating the averages ($\bar{X}$'s).

| | |
|---|---|
| $\bar{X}_A$ | |
| $\bar{X}_B$ | |
| $\bar{X}_A - \bar{X}_B$ | |

$\frac{(\bar{X}_A - \bar{X}_B) \times 100}{\text{Dwg. Tolerance Spread}}$ = _____ % Gage Difference

Figure 2

Let operator A make 10 readings on the 10 parts and enter in Column #1. Then have operator B make 10 readings on parts and *have his readings* recorded in column 4. *Do not let operator B see operator A readings.* Repeat this procedure with operator C, recording his readings in column 7. *Do not let him see readings of A or B.* Then repeat the cycle, using a different order of measurement respective to the first set of readings. Enter this data into columns 2, 5 and 8. Fill in columns 3, 6 and 9 by subtracting the smaller reading from the larger reading. These values are range estimates of the variability between the paired readings.

| EXAMPLE | Col.1 | Col. 2 | Col. 3 |
|---|---|---|---|
| 1 | +.0045 | +.0025 | .0020 |
| 2 | +.0005 | −.0005 | .0010 |
| 3 | +.0020 | +.0025 | .0005 |
| 4 | −.0015 | +.0005 | .0020 |

etc.

Note that entries in columns 3, 6 and 9 are all considered plus values.

Total all columns and enter totals in "column totals" line under proper column. Divide the "column total" by 10 to get the average and enter it in the "average" line.

Add the "average" of column 1 to the "average" of column 2 and enter the total in the line "Sum" under column 2. Do the same for columns 4 and 5 and columns 7 and 8.

Divide the sum of the averages by 2 in columns 2, 5 and 8 and enter these values in the lines $\bar{X}_A$, $\bar{X}_B$, and $\bar{X}_C$ under the appropriate columns.

Transfer the averages of columns 3, 6 and 9 in the appropriate locations (Block B) $\bar{R}_A$ (Col. 3 avg.), etc. Add, enter total in "Sum" line, divide by 3 and enter value as "R average."

Enter "R average" in $\bar{R}$——" line (Block C), multiply by 3.268 and enter result. This is the value of the limit of the individual R's. Compare entries in columns 3, 6 and 9 with this limiting value. Repeat those readings that produce a difference greater than the limiting value, using the same operator and part as originally used; or discard values and re-average and recompute $\bar{R}$ and limiting value.

Enter $\bar{R}$ (original or recalculated value if it was made) into the "$\bar{R}$ (recalculated)" line (Block D), multiply by 4.564 and record product. This value is the estimated 99 percent repeatability spread of the gage. This value multiplied by 100 and the product divided by the drawing tolerance spread yields the percentage value of the tolerance consumed by the repeatability (or more properly, the lack of exact repeatability) of the gage itself.

To determine the operator difference, the values of $\bar{X}_A$, $\bar{X}_B$, and $\bar{X}_C$ are entered in Block E and are compared by maximum difference and then this max. difference is multiplied by 100 and divided by the drawing tolerance spread. The resulting value measures the percentage amount of the tolerance consumed by the operator difference.

The total of "operator difference" and "repeatability" yields the percent of tolerance consumed by these two factors, and in our cases we have set the limiting value at 10 percent for repeatability and 4 percent for operator difference.

YOUR Report of PROCESSING QUALITY LEVELS is *SURE* to reach the FRONT OFFICE when you use R. G. BOCK P. Q. SCOPES with the QUALITY INDEX of STANDARD CONFORMITY.

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# Report of The Eleventh Annual Convention

## Detroit, Michigan, May 22, 23, 24

The end of a seemingly very short year of planning came for the Motor City's 11th Annual Convention Committee with the opening of registration desks at the Masonic Temple on Wednesday, May 22. The early risers of the more than 1500 persons who attended were waiting for the doors to open. Ninety speakers were making last minute reviews of their notes and 37 exhibitors were making final adjustments on their displays.

### Sessions

The first series of technical sessions started at 10:30 a.m. and was followed by the first of the three convention luncheons. Guest speaker at this luncheon was Dr. L. R. Hafstad, Vice President, Research Staff, General Motors Corporation, who spoke of the need for "T-Men,"—persons deep in their own specialized field and who yet had the appreciation of specialists in other fields —in order that the tremendous potentials of special fields might be coordinated to handle modern complexities.

He also challenged the people in quality control to explore other areas of management with their statistical techniques. There was little doubt that Dr. Hafstad found a responsive and enthusiastic audience.

### Technical Divisions

Annual meetings and dinners of the various Divisions and Technical Committees of the Society were held Wednesday evening prior to the Social Evening.

### Ladies Program

It was a very busy three days. From the many compliments received we feel sure all the ladies will remember the Detroit program for a long time. Testimonial letters and calls are still being received by the committee. A friendly host group served refreshing rolls and coffee in the Founder's Room of the Sheraton-Cadillac Hotel each morning. During Wednesday's coffee hour, Beauty Counselor make-up experts gave an excellent demonstration and a beautiful make-up kit for a door prize. On the same day, an afternoon tea, fashion and hair style show were given at the Women's City Club of Detroit. And there were ten lovely door prizes too!

In spite of the rainy weather everyone thought Thursday's Greenfield Village trip worthwhile and some plan to come back again in the future. Friday, Chrysler Corporation buses took 50 women to their plant to observe the assembly line methods. The entire program was wonderfully received and greatly enjoyed by everyone.

### Social Evening

The conversational topic Thursday centered around the fun everyone had at the social on Wednesday evening. The theme was Hawaiian with a Hawaiian boy and girl greeting everyone at the door with a lei. Ballroom decorations of overhead fishnets laden with starfish, seahorses, and other sea life blended with grass skirts and Hawaiian hats hanging from the walls. The dancing ended in the wee hours of the morning. Refreshments were served.

### Annual Banquet

"Sampling Plans Avoided." The prospect that all sampling techniques might be in for a severe setback was evident on Thursday, May 24th, as a capacity gathering of proponents of the principles of chance occurrence threw theory back to the texts and proceeded to engage en masse in a 100 percent inspection of the attributes of the 11th Annual Convention Banquet. The site of this event was the Grand Ballroom of the Sheraton-Cadillac Hotel. The object of this quality audit was Carbonnade of Beef preceded and followed by other taste tempters and completed in the light of flaming Baked Alaska that made any serious evaluation of visual characteristics impossible (although unnecessary). The Material Review Board left in a huff for the nearest diner, chairs were pushed back, and cigars lighted as the serious part of the evening got underway.

President Dale Lobsinger, looking as though he had weathered well his term of office, commented on the Society's steady growth to a membership in excess of 10,000; noted that the number of sections is now 97; and reviewed the year's activities, paying particular thanks to the officers and past-presidents of the Society for their help.

Mr. Lobsinger announced the election of the following members of the Society to the grade of FELLOW: James A. Curry, Benjamin Epstein, Deland H. Davis, Irwin A. De Grote, William G. Ireson, Gerald J. Lieberman, Domingo H. López, Obert B. Moan, and Frank H. Squires. The ability and activity of men such as these are in constant keeping with one of the Society's objectives which is to raise the status of the quality control engineering profession.

Herman Bogin received, as General Chairman of this "Motor City" 11th Annual Convention, a citation for the effort and work on the part of the Michigan Section as convention host.

"This gets tougher every year" was the comment of one member as Dale Lobsinger began announcement of the Saddoris Award for Section Management. The closeness of this year's race for top honors out of 97 sections was such as to cause everyone to agree on a hearty "well-done" and "hats off" to the winner, Corning-Elmira—a particularly noteworthy accomplishment for a section recently admitted. Congratulations to a mighty fine group!

Three authors cooperated in turning out the outstanding article in *Industrial Quality Control* entitled, "The Technique of Regression Analysis" which appeared in the August, 1955 (Vol. XII, No. 2) issue. The two male authors, Messrs. F. R. Del Priore and Edward Sax, gentlemanly deferred to their colleague, Miss Besse Day, who accepted the Brumbaugh award for the three.

The high point of the banquet occurred with the introduction of Dr. Edwin G.

Junior Past President Dale L. Lobsinger (left) presents the gavel of office to newly elected President Leon Bass.

L. R. Hafstad, vice President, Director of Research Staff, General Motors Corp., was the guest speaker at Wednesday's luncheon in the Fountain Room.

Olds as sponsor of the Shewhart Medalist for 1956. His text follows:

### *Sponsor's Remarks on the Award of the Shewhart Medal to Professor Mason Eaton Wescott**

As the sponsor for the Shewhart Medalist for 1956, I have the honor to present Dr. Mason Eaton Wescott. The official citation reads as follows: "In recognition of his work in quality control as educator, editor, and constant guide in the development of the Society's magazine, *Industrial Quality Control*. An understanding friend and a stout ally who has given freely of his services and talents."

It was on February 7, 1945 that Mason appeared as one of one-hundred and sixteen registrants for an eight-day course in Quality Control by Statistical Methods. The course was given by Ohio State University, with the assistance of the United States Office of Education. It was sponsored by the Office of Production Research and Development of the War Production Board.

There are two reasons why I begin with this historical statement. The first is personal. It was my privilege to serve as one of Mason's teachers and my first opportunity to get a glimpse of those fine characteristics for which we now revere and cherish him.

The second reason is more weighty. The date when Mason became an "eight-day wonder" (as students of the OPRD courses have been called) marked the beginning of Mason's whole-hearted devotion to the cause of quality control. It is for Mason's unusual services since that date that the American Society for Quality Control expresses its appreciation tonight.

For the record, it should be stated that Mason was born at Plattsmouth, Nebraska, was a Phi Beta Kappa at Northwestern, and received his doctorate in mathematics there in 1939. He came to the course at Ohio State with a fine background of experience in the teaching of mathematics and statistics, as a member of the Northwestern staff.

Mason returned to Northwestern in time to help with the teaching of an intensive quality control course in March of 1945. This was the first of some seventy similar courses with which he has so ably assisted during the past twelve years.

Early in 1945 the OPRD quality control program was moved to Carnegie Institute of Technology. During the summer of that year Mason came to Pittsburgh to help Holbrook Working and me issue a series of quality control reports. At the close of the summer, Mason returned to Northwestern but, fortunately, the opportunity to use his fine editorial ability was not long denied him. In October of 1946 he began to assist Martin Brumbaugh with *Industrial Quality Control* and, on July 1, 1947, he became Chairman of the Editorial Board.

In the ten years, during which Mason has guided our official journal, we have seen *Industrial Quality Control* grow in size, circulation, and quality. The number of pages per year and the circulation per issue have more than doubled. While the appraisal of quality trend on a numerical scale has not been attempted, it seems safe to predict that such a procedure would lend support to the qualitative judgement

*The full text of Professor Wescott's address appears on page 11 of this issue.

President Lobsinger presents the Shewhart Medal to Prof. Mason E. Wescott, who was selected as the 1956 Shewhart Medalist.

The 1956 Brumbaugh Award for the best article appearing in Vol. XII of *Industrial Quality Control* was awarded this trio of SQC stalwarts: (From left to right) Edward Sax, Bessie B. Day, and Francis R. Del Priore. Their article, "The Technique of Regression Analysis," appeared in the August 1955, issue.

that the movement has been steadily upward.

All of us can view, with great satisfaction, the ten fine volumes of *Industrial Quality Control*, which Mason has edited. Mason is the only one, however, who has complete knowledge of the hard work which he has contributed to these products and, therefore, to us, the beneficiaries. For ten years *Industrial Quality Control* has been the relentless task master which has demanded the lion's share of his time and energy.

To a lesser man, the service to our official journal might have seemed enough, but Mason has not been content to stop with this. In the earlier years he filled a leading role in the activities connected with the various Mid-West Conferences, serving on planning committees, appearing on programs, editing proceedings. Since coming to Rutgers in 1952, as Professor of Statistics, he has not only met his educational responsibilities, but also has found time to contribute to the success of many section meetings and conferences.

As most of us know, Mason's influence has not been confined to the United States. Late in 1952 he went abroad as a member of a team organized to carry the American version of statistical quality control to the industries of India. During his four-months' visit he helped with the presentation of training courses in many of the major cities. His work, and that of his associates, created an active interest in the installation and development of quality control programs throughout the country.

It is with a deep sense of gratitude for his many services in the field of statistical quality control that we honor Mason Wescott tonight by bestowing on him our highest award.

Mrs. Wade R. Weaver serves coffee at one of the morning coffee hours of the Ladies' program. On the receiving end this time is Mrs. Leon Bass.

After the Shewhart Medalist's address, the officers for 1957-58 were introduced as listed:

President:
Leon Bass

Vice Presidents:
Henry J. Becker
Clarence R. Burdick
C. E. Fisher
Ellis R. Ott

Executive Secretary:
L. S. Eichelberger

Treasurer:
J. Y. McClure

and the new executive directors are:

David G. Browne
Rocco L. Fiaschetti
Ralph D. Humphries
August B. Mundel
Harry G. Romig.

The banquet was ended on a merry note as President Lobsinger presented President-elect Bass with a gavel as symbol of his office and Past President Arthur Bender followed with a presentation to Dale Lobsinger of an apparently much-needed pair of binoculars so that Mr. Lobsinger might be better equipped to "look at something." Accompanying the binoculars was a "test chart" for determining the proper focus.

### Book Booth

The availability of a wide variety of books on quality control and related fields in a single area is probably the reason why the Book Booth continued this year to be a popular and congested area. Ably organized and directed by Wayne State University's Dr. Taylor, the choice editions of the library's large inventory were snapped up within hours leaving only remnants available on the last convention day.

A certificate of appreciation was awarded the Michigan Section for the fine work done in preparation for the Eleventh Annual Convention held in Detroit. Here, Herman Bogin, general chairman of the section's convention committee, accepts the award from President Lobsinger on behalf of the Michigan section.

The winner of the Saddoris Award for Section Management for 1956 was the Corning-Elmira section. Andrew P. Stergion is shown holding the award and flag while President Lobsinger reads the citation.

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**Production Engineer:** 2 years' production processing on amplifiers, transistor units and servo mechanisms.

**Senior Gyro Engineer:** Engineering degree with 5 years' related production experience. Must have ability to lead program to produce new gyro or inertial platform designs.

**Senior Electronic Engineer:** E.E. degree with 5 years' related electronics production experience. To lead electronic production program.

**Production Engineer:** B.S.M.E. or equivalent experience. 3 years' experience in processing electromechanical devices.

**Production Engineer:** B.S.E.E. or Physics degree. 3 years' experience in processing electronic devices. Magnetic amplifier experience preferred.

**Production Engineer:** B.S.M.E., B.S.I.E. or B.S.E.E. 3 years' experience in processing electromechanical assemblies.

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### *Exhibition*

In addition, the displays of this year's exhibition were extremely interesting and informative. It was the largest in the history of ASQC Conventions (by virtue of the number of exhibitors and floor area sold). Exhibitors and exhibit viewers alike attested to the high order of professional and capable handling of exhibits by Andrews, Bartlett, and Associates, Inc. Quality conscious QC men and women found a warm welcome waiting for them in each of the 37 product display areas; many quality problems were resolved in the exchange of experiences between visitor and exhibitors alike.

The following is a list of exhibitors: The Sheffield Corp.; Monroe Calculating Machine Co., Inc.; Sunnen Products Co.; Marchant Calculators, Inc.; Convair-Fort Worth Division of General Dynamics Corp.; Pratt & Whitney Co., Inc.; The L. S. Starrett Co.; Wilson Mechanical Instrument Division, American Chain & Cable Co., Inc.; M. E. Cunningham Co.; Federal Products Corp.; Service Diamond Tool Co.; American Cystoscope Makers, Inc.; Miles Reproducer Co., Inc.; Eder Instrument Co.; The Hughes Aircraft Co.; The Dow Chemical Co.; The Do-All Co.; The Warner & Swasey Research Corp.; Hamilton Watch Co.; The Johnson Gage Co.; The Martin Co.; The Electromark Corp.; The Bristol Co.; Unit Process Assemblies, Inc.; Basic Service Corp.; Brown & Sharpe Mfg. Co.; Jones & Lamson Machine Co.; Foster Engineering Co.; Triplett & Barton, Inc.; Custom Scientific Instruments, Inc.; International Business Machines Corp.; Republic Gage Co.; A. G. Davis Gage & Engineering Co.; Friden Calculating Co., Inc.; Karl Heitz, Inc.; A. O. Smith Corp.; Ford Motor Company.

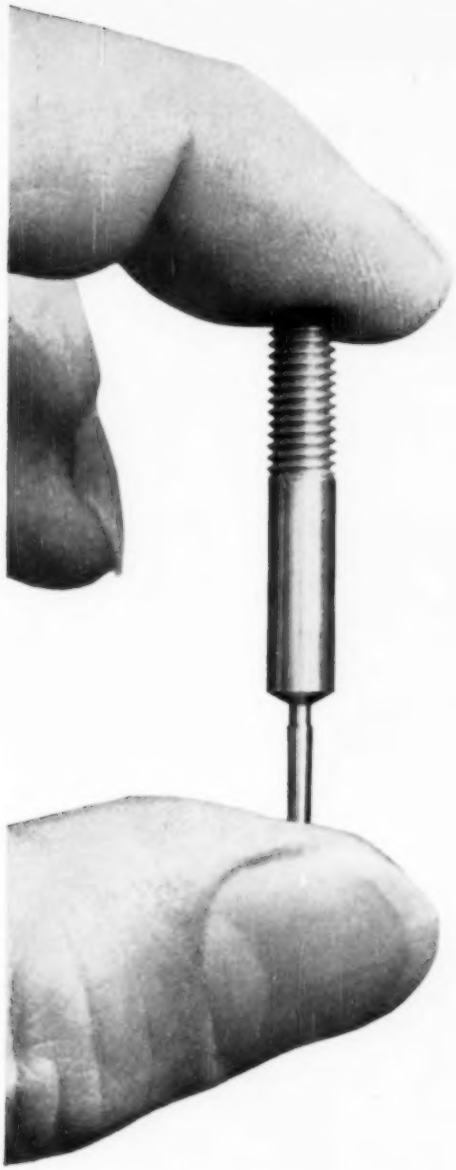
◆ ◆ ◆

### REPORT OF EXAMINING COMMITTEE

The Examining Committee has just announced the election of the following members to the grade of FELLOW:

| *Name* | *Section* |
|---|---|
| **Obert B. Moan,** | Los Angeles |
| **Frank H. Squires,** | Los Angeles |
| **Ing. Domingo M. Lopez,** | Mexico City |
| **Deland H. Davis,** | Michigan |
| **Irwin A. De Grote,** | Michigan |
| **Benjamin Epstein,** | Michigan |
| **George M. Cohan,** | Salt Lake City |
| **James A. Curry,** | San Bernardino |
| **William G. Ireson,** | San Francisco |
| **Gerald J. Lieberman,** | San Francisco |

The Officers of the Society wish to congratulate these members for achieving this distinction.



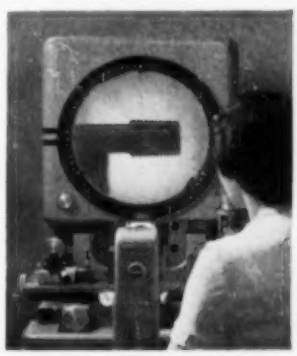
# How Minneapolis-Honeywell holds tapers to a tolerance of ± 2′ ...at a glance

**Small tapered needle valves at Honeywell's Brown Instruments Division are tough to gage quickly and accurately. Read how optical gaging makes the job easy.**

This tapered needle valve is used to reset a pneumatic process control system. Typical dimensions are 1 19/32″ overall with critical taper section less than ½″ long. The actual taper is 2°14′, plus or minus 2′. Since the valve only moves .030″ in regulating flow, accuracy is critical if the flow rate is to be precisely controlled.

This is the sort of measuring job optical gaging thrives on. At Brown Instruments Division of Minneapolis-Honeywell Regulator Company they use a Kodak Contour Projector to check these pieces at the rate of one every 2½ minutes, picking up not only taper but eight other dimensions and concentricity. With optical gaging they find accuracy is greater, since "feel" is eliminated. Production personnel can *see* any variation from tolerance—there's no disagreement between the manufacturing and inspection. And gage wear has been eliminated as a factor in reducing accuracy.

Got a tough-to-measure part like this? Is gaging taking too long or tieing up too many highly trained men? Is inspection holding up production? Optical gaging on a Kodak Contour Projector may be the answer. To find out more about how it can work for you, send for the booklet "Projection Gaging with Kodak Contour Projectors."



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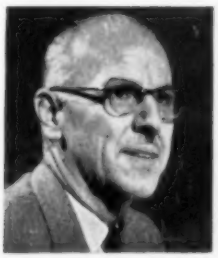

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# BOOK REVIEWS

*W. D. Baten, Editor*

*26 University Drive, East Lansing, Mich.*

**CURSO DE ESTADÍSTICA, VOLUME II, TEORÍA DE LAS MUESTRAS. PRUEBAS DE HIPOTESIS ANÁLISIS DE LA VARIANZA**, by Enrique Chacón, S. I. XVI plus 525 pages, published by Editorial El Mensajero Del Corazón De Jesús, Apartado 73, Bilboa 1956. Reviewed by W. D. Baten.

This book begins with ideas concerning randomness, random numbers, statistical games and various decision functions. Estimators are defined by use of unbiasedness, consistency, efficiency and sufficiency. Following this are explained the methods pertaining to maximum likelihood, minimum variance, least squares and minimum Chi-square. The next chapter contains discussions of the testing of hypotheses based upon Type I and Type II errors, together with sequential testing pertaining to regions of acceptance, or rejection and of doubt.

Chapter 31 deals with the statistics, the mean, the median, $(x_1 + x_n)/2$, $(x_3 + x_{n-2})/2$ and $(x_{a_1} + x_{a_2})/2$ as estimators when the variables follow the normal law; it also treats of their confidence limits and tests of hypotheses pertaining to them.

Chapter 32 shows that when the laws of the chance variables are the Poisson and the binomial, the estimator, X, is unbiased, consistent and efficient. Confidence intervals and tests of hypotheses are developed.

The next two chapters continue dealing with estimators, confidence intervals and testing of hypotheses when various statistics are known. The power of a test is presented.

Chapter 35 deals with testing normality of frequency distributions by use of values of $\alpha_3$ and $\alpha_4$ and non-parametric tests pertaining to frequency distributions. The author then shows how to determine the type of the distribution by tests of Kolmogoroff, Marshall, Smirnoff-Cramer, Moran and Kimball and Sherman.

The next chapter presents parametric tests for determining differences between two arithmetic averages under various assumptions concerning the frequency laws and the standard deviation; these tests are of Behren-Fisher, Darmois and Welch. There are sections on transforming the chance variable by the arc sin and square method, and also the use of binomial probability paper.

Chapter 37 treats of non-parametric methods for testing differences between two averages when the frequency distributions of the chance variables are unknown by use of the method of signs, method of Walsh and methods of repetitions. A test of the median is given.

This is followed by comparisons of two variances by the F-test under 3 hypotheses. The power of the test is discussed together with the O.C. curve. Other ratio tests are given.

Chapter 39 shows how to compare tw aggregates; first, when the variables follow definite laws and one desires to know whether or not the parameters coincide; and second, when the distribution laws are unknown and one desires to determine from the samples whether or not they follow the same distribution. These tests are explained by means of accumulated functions, tests of Kolmogoroff and by means of the S of Marshall.

This is followed by comparisons of various aggregates under various assumptions about the laws, the means and the standard deviations.

Chapters 41 and 42 take up tests involved in the analysis of variance for one, and many, classification layouts by assuming various mathematical models, together with analyses for Latin squares and Graeco-Latin squares.

These are followed by a comparison of various aggregates where the variables follow the normal curve. Chapter 44 presents regression, the standard error of estimate and the intervals of confidence for the regression coefficients. Chapter 45 shows how to compare linear regressions and the various coefficients. Confidence intervals for these statistics are also obtained.

Chapter 46 deals with distributions in two chance variables and estimates of parameters, their confidence limits and tests of hypotheses by the method of maximum likelihood. Here is presented the linear Pearson correlation coefficient, the rank correlation coefficient, the tetrechoric and biserial correlation coefficient.

Chapter 47 takes up multiple regression, multiple correlation, develops intervals of confidence for the various coefficients and tests hypotheses about the coefficients.

The last chapter deals with determining the randomness of observed data.

The book contains 29 important tables for the various methods and tests.

There are not enough interpretations throughout this text.

**NONPARAMETRIC STATISTICS FOR THE BEHAVIORAL SCIENCES**, by Sidney Siegel, 312 plus XVII pages, published by McGraw-Hill Book Company, Inc., New York, 1956. $6.50. Reviewed by W. D. Baten.

In the beginning the author explains clearly the difference between parametric and nonparametric tests, together with their advantages and disadvantages Explanations of the null hypothesis and alternate hypotheses are adequately presented with regions of acceptance and rejection. Levels of significance are treated with their probabilities. The power of a test is defined and illustrated with a diagram, together with the meaning of Type I and Type II errors. Power-efficiency is discussed. Various kinds of measurements are explained with four classificatory scales viz. nominal, ordinal, interval and ratio. This introductory material shows the reader the object of the book and makes a good setting for the material to follow, which includes ideas about the binomial test, the Chi-square test for one and more than one sample, the Kolmogoroff-Smirnoff test, test involving runs, the McNemar test, the sign test, the Wilcoxon matched-pairs signed-rank test, the randomization test for matched pairs, the Fisher exact probability test, Tocher's modification of Fisher's test, the median test, the Mann-Whitney U test, the Goodman test, the Wald-Wolfowitz runs test, the Moses test of extreme reactions, the extension of the median test, the Kruskal-Wallis one-way analysis of variance by ranks, the Cochran Q test and the Freedman two-way analysis of variance by ranks, correlation, Spearman rank correlation coefficient, the Kendall

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1957. 645 pages. 136 illus. $12.00.

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1957. 617 pages. Illus. $10.25.

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By E. M. MAC NIECE, Johnson & Johnson Co.

An integrated, up-to-date survey of the methods and techniques of production management, illustrating principles with specific examples of effective applications. New in the second edition are: a chapter on automation; a chapter on specialization, standardization, and simplification; material on operations research and ratio-delay analysis; a section on level production and its relation to guaranteed annual wages; and a first-hand report of production engineering practices in Europe.

1957. 374 pages. Illus. $8.25.

## 4. THE ELEMENTS OF PROBABILITY THEORY AND SOME OF ITS APPLICATIONS*

By HARALD CRAMER, University of Stockholm

A compact, readable discussion of the mathematical theory, emphasizing random variables and probability distributions. Offers a fruitful survey of the important applications—particularly as they affect modern statistical theory and practice.

1955. 281 pages. Illus. $7.00.

## 5. STATISTICAL SAMPLING for AUDITORS and ACCOUNTANTS

By LAWRENCE L. VANCE, University of California; and JOHN NETER, University of Minnesota

Let this new book show you how to handle your sampling problems more objectively and efficiently. Answers such questions as: how big a sample to take; how to select a sample; how to interpret the sample after it is examined; how to substitute sampling for complete counting of such things as inventory, with the degree of precision specified.

1956. 310 pages. $9.00.

## 6. NONPARAMETRIC METHODS IN STATISTICS*

By D. A. S. FRASER, University of Toronto

Nonparametric methods which have developed so rapidly since the postwar years are collected and unified in this book. The author treats nonparametric theory as an integrated part of statistics and presents nonparametric forms of standard statistical problems for both large and small samples.

1956. 316 pages. $8.50.

## 7. BUSINESS FORECASTING IN PRACTICE

**Principles and Cases**

By ADOLPH G. ABRAMSON, SKF Industries, Inc., and RUSSELL H. MACK, Temple University

The first detailed explanation of the methods by which today's business forecasts are prepared, described step by step, by six skilled forecasters in various fields—durable and non-durable goods manufacturing, finance and distribution.

1956. 274 pages. Illus. $6.50.

*One of the Wiley Publications in Statistics, Walter A. Shewhart and S. S. Wilks, Editors.

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partial rank correlation coefficient, the Kendall coefficient of concordance, W. Tests are included for dependence which will be welcomed by many research workers.

The use of every test is well illustrated, together with explanations for securing all necessary calculations. The author has not attempted to give the mathematics underlying the development of the above tests but cites the literature, presents methods for carrying them out and interprets their results. This book will introduce the reader to the meaning of nonparametric statistics and will enable him to understand, to appreciate and to use this rather new phase of statistics.

In the appendix there are 21 tables giving critical values or probabilities pertaining to all the tests and coefficients presented which make the book valuable, for the student has all the necessary information in one small book for carrying out the various tests. I do not know of one source which contains so much information about this subject, on the level on which it is written, as found in this book.

**A NEW APPROACH TO ENGINEERING TOLERANCES** by J. Gilson, published by Machinery Publishing Company, Brighton, England, 99 pages, 6 × 9, clothbound. (Available in the U. S. through Industrial Press, 93 Worth Street, New York 13.) Reviewed by N. L. Enrick.

This booklet is subtitled: "A Critical Presentation of the Considerations Necessary for the Allocation and Maintenance of Realistic Tolerances in Modern Economic Production." The material is presented in a form that should make it readily understandable and acceptable to the practical man in the shop. Beginning with a general consideration of the functions of tolerances for various production processes, the author then demonstrates the fallacy of orthodox allowances and shows how statistical addition of variances accomplishes more realistic tolerancing. Also included in the treatise are methods of expressing tolerances on drawings so as to simplify their checking during production, the standard limit and fit systems, and a final chapter of various practical hints. Includes a bibliography.

**CORRECTION.** In the review of *Quality Control Through Statistical Methods* by Norbert Lloyd Enrick which appeared in the May 1957 issue, page 68, the price was listed as $2.00. This price is in error. The correct price for this book is $5.00.

# ASQC NEWS

## *Thank You*

The sincerest thanks of the Society are extended to the Milwaukee Section for its generous and timely contribution of $500, made last month. The Section specified that the money be used to defray the cost of printing the new membership brochure. This brochure, modern in its design, has appeal and contains much useful information about the Society. All Sections will find it helpful in membership work; it is expected that an adequate supply will be available in a few weeks.

The cooperation of the Milwaukee Section is particularly appreciated at a time when the Society's financial situation, following failure of the dues increase proposal to receive membership approval, requires that expenditures be made for only the essential items of Society operation. Many similar projects need financial support and the help of all Sections is welcomed.

The Metropolitan Section has likewise responded in a very generous manner to the Society's recent request for special financial support for its activities. The Section's Executive Committee, at its meeting in New York early last month, voted, as an initial step in its part of this program, to give to the Society, an amount equal to $2.00 for each of its members on record as of the end of the past fiscal year (June 30, 1957).

The Section's outstanding program for the year and its splendid membership growth are a tribute to the fine leadership of its officers and to the good work of its many committees and members. The Society is grateful for this type of activity which has furthered the objectives of ASQC and which, in addition, has made possible this financial assistance. With the Section membership approaching 800, the amount of this contribution is substantial.

### *NOTICE*

The amendment proposal to increase membership dues from $10 to $12 for the Member and from $12 to $15 for the Senior Member and Fellow, submitted at the time of the Annual Postal Ballot, was defeated. With slightly more than 30 percent of the membership voting, ballots in favor of the amendment were just short of the 75 percent required for adoption. Thus, the dues for the 1957-58 fiscal year remain at the $10 and $12 figures, and dues statements reflecting these amounts have been mailed to all members (or Sections). Prompt payment of dues will be of considerable help and you are urged to do so at once.

### *Our Ever-Growing Family*

With the addition of Phoenix (Ariz.), the number of sections in the Society is now 98. The Society is proud to extend a most cordial welcome to this new section.

**98—Phoenix (Dist. 16)**

Chairman: A. R. Pennell
Motorola Lab, Inc.
Phoenix, Ariz.

Vice Chairman: J. H. Corrington
Phoenix, Ariz.

Secretary: Eugene E. Kirsch
General Electric Co.
Phoenix, Ariz.

Treasurer: W. T. McGinnis
Phoenix, Ariz.

# Stock List

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| ***INDUSTRIAL QUALITY CONTROL*** | |
| Vols. I-X (July 1944—May 1954) | $6.00 per vol. |
| Vol. XI (July 1954—June 1955) | $9.00 |
| Vol. XII, XIII (July 1955—June 1957) | 10.00 per vol. |
| Individual Back Copies | 1.00 |
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| **ASQC STANDARDS SERIES** | |
| (4) A1-1951 "Definitions and Symbols for Control Charts" | .50 |
| **GENERAL PUBLICATIONS SERIES** | |
| (5) General Publication No. 2, "Manual for Authors of Technical Papers for Publication in Industrial Quality Control" | —— |
| (6) General Publication No. 3, "Span Plan Method of Process Capability Analysis" | 2.00 |
| **CONVENTION TRANSACTIONS** | |
| (7) Fourth Annual Convention "Convention Papers (10 papers) Unbound | 30 ea., complete 2.50 |
| (8) Sixth Annual Convention "Quality Control Conference Papers 1952" (47 papers) Bound Volume | 3.50 |
| (9) Ninth Annual Convention "Quality Control Convention Transactions 1955" | 3.50 |
| (10) Eleventh Annual Convention "Quality Control Convention Transactions 1957" | 3.50 |
| **CONFERENCE PROCEEDINGS** | |
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| (12) Midwest Region, 1955 "Quality Control Technical Papers" 16 papers (bound volume) | 3.00 |
| (13) Proceedings of the Eighth Annual Rutgers All Day Conference, September 8, 1956 | 2.00 |
| (14) "Textile Quality Control Conference Papers," Vol. 2, 1955 28 papers (bound volume) | 5.00 |
| (15) "Textile Quality Control Conference Papers," Vol. 3, 1956 26 papers (bound volume) | 5.00 |
| **MISCELLANEOUS** | |
| (16) ASTM Manual on Quality Control of Materials | 2.25 |
| (17) Quality Control in Central New York Industry—"A Casebook" (15 papers) Bound Volume | 1.00 |
| (18) NSMPA Manual on Statistical Quality Control Volume I, "What and Why" | 1.00 |
| (19) NSMPA Manual on Quality Control Sampling Volume II, "Highway Markers to Better Quality" | 1.00 |
| (20) NSMPA Manual on Sampling Inspection Volume III, "Do It Yourself Sampling Inspection Installation" | 1.25 |
| *NSMPA Manuals, Vols. I-III when purchased at same time* | *3.00* |
| (21) A. J. Duncan, "Use of Ranges in Comparing Variabilities," Reprint from IQC Vol. XI, No. 5, February 1955 | .25 |
| (22) SAMA—"Quality Control and Research" | .35 |
| (23) Charles R. Hicks, "Fundamentals of Analysis of Variance," Reprint from IQC Vol. XIII, Nos. 2, 3, 4, August, September, October, 1956 | .45 |

**L. S. EICHELBERGER, EXECUTIVE SECRETARY**
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# section briefs

The ALLENTOWN-BETHLEHEM section is holding a summer clambake on Aug. 16 at Beethoven-Waldheim, Hellertown, Pa., beginning at 6 pm.

The next meeting of the HUNTSVILLE section will be July 27, 7:00 pm, at Decatur, Ala., when William Spink, quality analyst with the Chemstrand Corp., will present "QC techniques–synthetic fiber industry."

### ALBUQUERQUE

The section heard A. Burton Metzger, Sandia Corp. safety director, discuss accidents and the human factor at a dinner meeting held May 14 at La Placita, Olyd Town. The problem is certainly not insurmountable assured Mr. Metzger in a highly interesting talk entitled "We can be our brother's keeper."

### ALLENTOWN-BETHLEHEM

Dr. Ellis Ott spoke at the May 9 dinner meeting telling a capacity crowd "How to organize and operate statistical quality control." The section's newly elected officers were announced at that meeting. They are: chairman–Bryn Hammerstrom; vice chairman–Dave Hilder; secretary–Richard Wetherhold; treasurer–Don Yateman. A larger executive committee has been formed to serve the expanding section.

### BOSTON

The second annual picnic on May 18 was hampered by rain. In spite of the unpleasant weather, *ten* members and *twenty-five* wives showed up anyway. The group adjourned to a nearby restaurant for lunch.

The Boston 1958 Host Committee observed the recent convention in Detroit and are getting ready for a year of hard work.

*(Ed: Now, let's see–25 divided by 10 is 2.5 per member. Where Do I Apply?)*

### BUZZARDS BAY

Richard Cotter of Speidel Corp. in Providence discussed "Applications of frequency distributions in industry" at the May 14 meeting. New officers installed include: Kenneth Bennett, chairman; John Ruggles, vice chairman; James Burke, secretary; Jeraldine Habicht, treasurer.

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### CHICAGO

A plant tour, sponsored by the St. Charles-Fox Valley subsection, was held May 28 prior to the business meeting. Members and guests were shown the facilities of the Burgess-Norton Mfg. Co., Geneva, Ill.

The following officers were elected by the Chicago section: chairman–Eugene G. Freund; vice chairman–William L. Lieberman; secretary–Irwin H. Pollack; treasurer–Howard L. Jones.

The St. Charles-Fox Valley subsection elected the following: chairman–Stephen White; vice chairman–Ray Swenson; corresponding secretary–A. J. Bartoletto; treasurer and recording secretary–Robert Messier.

### CLEVELAND

Election results for the section were announced at the May 3 meeting. The new officers are: chairman–Paul Kuckuck; vice chairman–Charles H. Joseph; secretary–James Oesterling; treasurer–Norman Burkhardt. Speakers at this meeting were Dr. and Mrs. Ellis R. Ott who presented a fine program in their concurrent talks.

### CORNING-ELMIRA

"Management night" featured Dorian Shainin who spoke on "Breaking through industrial problem barriers." R. L. Fiaschetti officially presented the section charter to S. J. Cherry, first chairman of the section. Mr. Cherry and E. B. Godsey were presented Steuben crystal for their participation in the section's education program.

### GEORGIA

A joint meeting of the section and the Atlanta group was held at the Georgia Institute of Technology, Atlanta, on May 31. Three presentations included: "High-low quality chart for individuals" by E. G. Field, consulting management engineer, Atlanta; "Customer acceptance measurement in the telephone industry" by W. B. Scott, Jr., Southern Bell Telephone & Telegraph Co., Atlanta; and "Use of MIL-STD-105A" by E. B. Windish, Office of Inspector of Naval Material, Atlanta. This was followed by a report by Dr. J. J. Moder, Jr., Georgia Tech., on the results of a recent questionnaire to section members concerning programs desired for the coming year.

### HARRISBURG

D. A. Taylor of the Frieze Division, Bendix Aviation, spoke at the May 1 meeting held at the American Legion hall in Harrisburg before 55 members and guests. His subject was "Some QC applications–statistical and non-statistical."

### HUNTSVILLE

The section met May 27 in Decatur, Ala. Matthew Weber, Thiokol Chemical Corp., Redstone Division, presented a paper by Ervin F. Taylor of Westinghouse Atomic Fuel Dept., titled "The frequency distribution analysis sheet." This program was another in the series of presenting papers by proxy. This type of programming has been highly successful and is recommended for small sections with limited funds for financing programs.

### KANKAKEE-JOLIET

The annual election in May resulted in the election of the following officers: chairman–Charles L. Barron, Ordnance Ammunition Command; vice chairman–Warren J. Chamberlain, General Foods; secretary–Mary L. Egges, General Foods; treasurer–Charles A. McAllister, U. S. Rubber Co.

### KANSAS CITY

The section installed the newly elected officers at the May 11 meeting. The meeting was held at the suburban home of William Atwater in conjunction with a picnic which included the members' families. The new officers are: chairman–Michael L. Blessing, Black-Sivalls-Bryson; vice chairman–Jay R. Rumberger, Westinghouse Electric Co.; secretary–Robert W. Week, Westinghouse Electric Co.; treasurer–Richard W. Miller, Vendo Co.

### LOS ANGELES

"Planning for management" was discussed by an adroit panel consisting of Dr. Harry A. Romig, Summers Gyroscope Co.; Henry I. Matosoff, Kwikset Locks, Inc.; and Earl Chandler, North American Aviation. Dr. Romig served as chairman.

### LOUISVILLE

Widespread interest in quality control departmental organization, budgets, and functions among manufacturers in this area instigated a survey by a committee under the leadership of William Collinge. This data, presented at the May meeting, is now offered as a service to all section members as a reference.

The new officers for the section are: chairman—Allen Greene, Jr., General Electric Co.; vice chairman—William J. Alexander, Reynolds Metals Co.; secretary—Flora Jurgens, Colgate-Palmolive Co.; treasurer—Robert Rottman, Philip Morris Co.

### MEMPHIS

The May meeting was held at the Memphis Mills of the Kimberly-Clark Corp. The technical department presented a program entitled "Quality control activities at Kimberly-Clark." John Bates, technical superintendent, was assisted by Boyd McDaniels, Archie Le Compte, and Maurice Brandon. A plant tour followed the meeting.

### METROPOLITAN

An all-day conference will be presented Saturday, Sept. 7, at Rutgers University. The following areas will be covered; a course for management for SQC; applications in the electrical and mechanical industries; application in pharmaceutical and chemical industries; advanced statistical techniques; management aspects of quality control; quality control in the ceramic industry; administrative applications. For further information write: Chairman F. Bruce May, Johnson & Johnson, New Brunswick, N. J.

### MID-HUDSON

The May meeting was held at Beekman Arms, Rhinebeck, N. Y. Guest speaker was Edwin Schecter, assistant director of quality control at the Sonotone Corp., whose main topic was "The application of control charts in analysis of experiments."

### MILWAUKEE

The Elks Club was the scene of the section's annual business and social meeting on May 13. Heaps of food and drink kept the members full and happy while listening to a fine barbershop quartet and watching movies of the Milwaukee Braves and Green Bay Packers.

New officers for the coming season are: chairman—Wm. Golomski, Marquette University; vice chairman—James Barrabee, International Harvester Co.; secretary—Larry Neuman, Miller Brewing Co.; treasurer—Peter Gates, A. Geo. Schulz Co.

### MUNCIE

K. E. Ross addressed our meeting of May 16. His subject was "Index of variability—P charts." It turned out to be a lively and profitable meeting. We feel we ended the season on a high note and we're planning big for next season!

### NEW HAMPSHIRE

The section, under the guidance of chairman Wesley Gahagan, completed its most successful season. Five meetings were held at different industrial locations with plant tours made at each. These tours plus an excellent cast of speakers helped produce an average attendance of 60.

The new officers are: chairman—Carl Laurier, Scott & Williams; vice chairman—Charles Tallman, U. S. Rubber; Secretary-treasurer—Leroy Lindgren, Joy Manufacturing.

### NORTHEASTERN INDIANA

The 10th annual conference was held May 2 at the Chamber of Commerce, Fort Wayne. There were four very excellent speakers who addressed the section. They were Richard S. Bingham, Jr., senior engineer for the Carborundum Company; Julian H. Toulouse, Owens-Illinois Glass Co. and former Society vice president, John N. Albaugh of the Farnsworth Electronics Co.; and Warren E. Jones, who is a consultant from Des Plaines, Ill.

New officers were installed at the conference. They are: Ed Bird, Dana Corp., chairman; I. H. Cline, General Electric Co., vice chairman; J. E. Goldress, General Electric Co., secretary; and A. E. Carter, Dana Corp., treasurer.

### OMAHA-LINCOLN

The section held its May meeting at the Capitol Hotel in Lincoln. Thirty members were present to hear an interesting talk by R. H. Ede of U. S. Steel Co. His subject was "QC in steel manufacture."

### ROCHESTER

New officers for 1957-58 are: president—Elmer F. Lalonde, Eastman Kodak Co.; vice president—William H. Harrison, Bausch & Lomb Optical Co.; secretary-treasurer—W. Carl Jensen, The Haloid Co.; executive secretary—Russell C. McCarthy, Industrial Management Council.

### ST. LOUIS

For their annual spring party the section had a square dance at the Hillcrest Manor House, Hillcrest Country Club, also at which the officers for the coming year were installed. The dance was a huge success even for the beginners.

The new officers are: president—William H. Von Meyer, Barry-Wehmiller Machinery Co.; vice president—Samuel H. Huston, Mallinckrodt Chemical Works; secretary—Simon D. Krasner, Ramsey Corp.; treasurer—E. Harvey Barnett, Monsanto Chemical Co.

### SALT LAKE CITY

Following a dinner at the University of Utah, members and guests assembled to hear Jack A. Murphy, statistics manager of United Air Lines, speak on the subject "Collecting source information to develop operational controls." Mr. Murphy's address included the presentation of this data to top management and also the methods developed by United in graphic presentation. The equipment used in the graphic presentation attracted considerable attention, and the questions asked regarding the methods of presenting operating data attested to the interest in the subject.

### SOUTH BEND-MISHAWAKA

"Quality control in the steel industry" was the subject of the talk given by Dr. Ernest B. Mayer of the Ryerson Steel Co. of Chicago at the annual business meeting held in May.

Ferd Krueckeberg, assistant director of the committee of 100 of South Bend and Mishawaka, presented awards to out-going officers of the organization. Robert Fitzgibbons, chairman, introduced officers and committee chairmen who summed up their activities for the year.

### SOUTH TEXAS

Forty-seven members and guests attended the May meeting which consisted of a plant tour of the Diamond Alkali Com-


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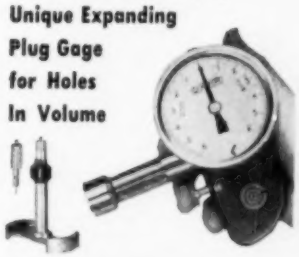

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pany's Deer Park plant and a paper by C. F. Lewis of Cook Heat Treating Co., Houston.

Officers for the 1957-58 season were elected. The successful candidates were: chairman—J. G. McQuarrie; vice chairman—Ken Kenecaster; secretary—Richard Shappee, and treasurer—A. R. Stark.

### SOUTHERN CONNECTICUT

On May 8 the section held its 8th annual banquet. One hundred twenty-two members and guests enjoyed the dinner which was followed by Sidney Radner, internationally famed lecturer on card cheats.

Guy Cohen of the Glenn L. Martin Co. spoke and showed films about project vanguard, the earth satellite launching vehicle.

### TORONTO

At the last speaker meeting of the 1956-57 season the section was addressed by Harold L. Freeman, quality control engineer, General Electric Co., New York, who spoke on the responsibilities of a quality control engineer.

### TRENTON

The final meeting of the section was a plant visitation of the Yale & Towne Co., Philadelphia, Pa., a leading manufacturer of material handling equipment. Mr. Goodman conducted the tour.

Newly elected officers are: chairman—Richard M. Fox, Office of Inspector of Naval Material; vice chairman—Richard G. Storm, U. S. Steel Corp. Fairless Plant; secretary—Mary A. Flynn, Air Force quality control inspector; treasurer—John J. Wargo, Ternstedt General Motors Corp.

### • • • SIGNIFICANT DIFFERENCES

. . . The following promotions of Chicago section members were recently announced by the Victor Adding Machine Co. Eugene Freund, former quality control manager, is now in charge of development of a work simplification program; Robert Majeski has been promoted from quality control engineer to quality control supervisor; Edward Lukowski is now acting quality control manager in addition to his regular duties as chief inspector.

. . . Dr. Harry E. Sagen of the Chicago section has been elected a vice president of the Chicago Technical Societies Council which represents 32 technical societies including ASQC.

. . . Samuel Orsini of the Corning-Elmira section has been appointed process and quality engineer for the Wellsboro, Pa. plant of the Corning Glass Works.

. . . Bendix Aviation of Kansas City recently announced the appointment of H. C. Heyde as manager of quality control. Mr. Heyde is a senior member of the Kansas City section.

. . . Ralph Van Osinski, formerly chief inspector of Indiana Metal Products moved to the Elgin Division of the Chicago Rawhide Co. in the capacity of quality manager. Mr. Van Osinski is a member of the South Bend-Mishawaka section.

. . . Philip B. Crosby, formerly with the Missile Div., Bendix Aviation Corp., has accepted a staff position in the Reliability Department of Martin Aircraft Company's new Missile Division in Orlando, Fla. Mr. Crosby is a member of the South Bend-Mishawaka section.

. . . Toronto section member Ed Hughes, quality control supervisor at Avro Aircraft, Malton, Ont., was appointed to the post of chief inspector at Canadian Steel Improvement, Ltd., Toronto, Ont.

. . . Joseph P. Cronin, Binghamton section secretary, has been appointed to the position of manager, subcontract parts and units inspection, second shift, in the Endicott plant of International Business Machines Corp.

It is with deep regret that the Metropolitan section reports the death of Raymond L. Thatcher on May. 18, 1957. Mr. Thatcher was 44 years old and director of the Quality Control Division of E. R. Squibb, Division of Olin Industries, in the New Brunswick, N J. plant. A graduate of the Rutgers College of Pharmacy in 1934, Mr. Thatcher was also in the first group of candidates to receive the Masters Degree in the Graduate Program of Mathematical and Applied Statistics at Rutgers University.

## RUTGERS CONFERENCES

A six-day advanced conference series on "Applied Statistics and Statistical Quality Control" will be offered by Rutgers—the State University, New Brunswick, N. J., Sept. 4-11. This advanced course is designed to provide additional instruction for persons who have had both a basic course and industrial experience in the SQC field.

It will include advanced topics in SQC such as sampling by variables, tests of significance, narrow limit gages in process control, sampling in chemical processes, practical designs of experiments, "trouble-shooting" in production, corelation and regression, management aspects of a quality control program. Familiar techniques will be extended and new ones presented to provide an integrated approach to industrial problems. Individual industry interests are served by providing laboratory sections grouped by area-interest; especially chemical, electrical, mechanical and advanced statistical techniques.

The full-time Rutgers staff members who will be associated with this advanced conference are: Professors Ellis R. Ott, Herman B. Wagner, and Mason E. Wescott. Special lecturers will include: J. Stuart Hunter, Enoch B. Ferrell, Allen R. Crawford, Richard S. Bingham, A. B. Mundel, and Paul S. Olmstead.

Tuition is $150 which includes text and instructional material. For additional information, write to Professor Ellis R. Ott, or Professor Mason E. Wescott, Rutgers University, New Brunswick, N. J.

Orlando E. Panfile, by day quality control manager of the Bloomfield electron tube plant of Tung-Sol Electric, Inc., and by night an instructor on the co-adjutant staff of Rutgers University, demonstrates statistical quality control to his graduate students at the plant.

A special Rutgers two-day conference on "Quality Control and the Consumer" will be held on the New Brunswick Campus of Rutgers—the State University on Thursday and Friday, Sept. 5-6. This is a new venture dedicated to better communications between those developing the industrial science of quality control and those more directly interested in the ultimate consumer. An outstanding program has been arranged, tentatively, and will include such topics as. "How Backward is the Art of Spending Money" by Dr. Colston Warne, Amherst College; "An Action Appraisal in Industrial Psychology,"

Dr. Roger Bellow, Rutgers University; "Development of Industrial Standards, the basis for the mass production economy," Vice Admiral George Hussey, Jr., American Standards Association; "Enforcing Health Standards Through Sampling," Dr. William Weiss, Food & Drug Administration; "Rating Consumer Products Through Laboratory Testing," Dr. Morris Kaplan, Consumers Union; "Statistical Designs of the Testing of Consumer Goods," Dr. Harold Freedman, Massachusetts Institute of Technology; "Will Quality Surveillance Plans Enforce Quality Standards Desired by Consumers?", Mr. John Riordan, Department of Defense, Washington, D. C.

Facilities at the University are limited for lodging and meals, and it is essential that you pre-register. The total cost for the two-day period, including meals and lodging and a copy of the papers, will be $16.00. This is a pioneering project which will be important to many persons in fields bordering on the quality control function. For further information, write Professor Mason E. Wescott, Rutgers University, New Brunswick, N. J.

# What's New?

**ROY A. WYLIE, *Editor***

*When inquiring about "What's New?" items, please mention INDUSTRIAL QUALITY CONTROL*

A new, low cost, U. S. Government approved material for aqueous phase magnetic particle inspection of metal to detect flaws has recently been developed by **Harry Miller Corp.**, 4th & Bristol Streets, Philadelphia 40, Pa. Called IMMUNOL 438, the material replaces kerosene and mineral spirits, gives a better definition of flaw and prevents rusting of the metal. IMMUNOL 438 is nonflammable, odorless, and self-cleaning. One drum of this material replaces many drums of solvent. The specified mixture is 1 part IMMUNOL 438 to 17 parts water, and this mixture suspends uniformly either fluorescent or nonfluorescent paste. The Air Force and other Government Agencies recently approved the water suspendable method of magnetic inspection providing IMMUNOL 438 is used.

★ ★ ★

The **Baldwin-Lima-Hamilton Corp.**, Philadelphia 7, Pa., has introduced a new differential pressure cell with increased capacity and accuracy for measuring fluid pressure. The FMM unit is one of a series of Baldwin SR-4 strain gage pressure cells which measures pressures of fluids ranging from human blood to gases in rocket chambers. Like other Baldwin-Lima-Hamilton transducers, the FMM requires low voltage and is completely sealed so that it may be installed in hazardous environments. The new cell is widely applicable in industrial measurement and is particularly suited for wind tunnel work, in which it replaces banks of manometers. The new cell and other SR-4 transducers, when used with high speed analog to digital scanning equipment, provide the fast response necessary to facilitate processing masses of data in very short periods of time. The highly accurate analog signal is easily used in any type of indicating, recording or controlling instruments and is easily convertible for analog to digital computation.

★ ★ ★

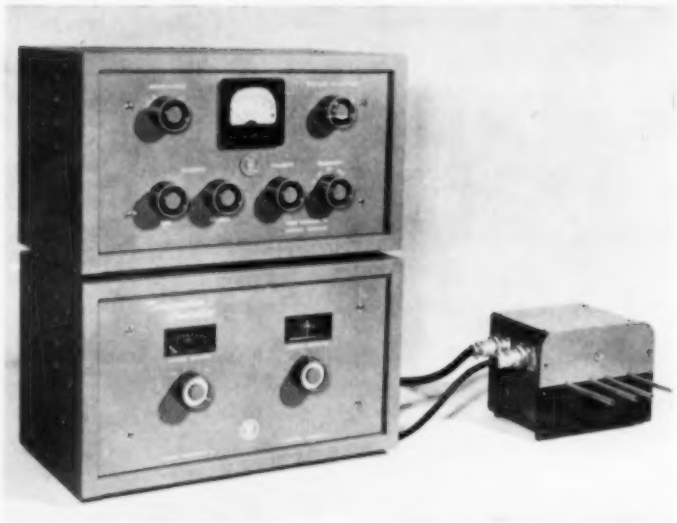
The new Eli Whitney Metrology Laboratory of the **Sheffield Corp.**, Dayton 1, Ohio, is making available a comprehensive contract service to provide industry with an efficient

An important item in each year's Saddoris Award Judging is the section scrapbook. The judging this year was done through the courtesy of Owens-Illinois' Merchandising and Advertising Division. Participating in the judging of this year's scrapbooks are (left to right) Rosemary Carroll, secretary of the Saddoris Award Committee; Bob Johnson, creative advertising specialist; Bert Herron, director of advertising; John Zabowski, creative advertising specialist; and Julian H. Toulouse, chairman of the Saddoris Award Committee.

and systematic method for checking and calibrating gage blocks to maintain precision measurement standards in manufacturing. The checking and calibrating of all varieties of gage blocks usually employed in most precision manufacturing operations will be performed by the company's staff of metrology specialists. The laboratory claimed to be the world's most complete private facility outside U.S. and foreign government standards bureaus, is equipped to calibrate all types of gage blocks to light-wave standards of precision. Growing precision requirements in industry have placed a severe burden on U.S. Bureau of Standards laboratory facilities and resulted in long and often costly delays. The new contract service offered by Sheffield is designed to ease the burden on government facilities and to give industry faster service.

★ ★ ★

**Barnes Engineering Co.**, Stamford, Conn. has developed a new high temperature thermal conductivity cell to extend the effective operating range of chromatographic analyses. The Model 75 cell is designed to operate over a range of 30 degrees C. to 325 degrees C., and will accommodate liquids with boiling points up to 475 degrees C. This is virtually at the upper operating limit of chromatography, as beyond this point organic molecules begin to break down. The cell may be incorporated into any existing chromatographic apparatus. Stability and sensitivity is achieved at these high temperatures by use of flake thermistors as the sensing elements. The Model 75 thermal conductivity cell consists of three separate units: 1) The detector proper enclosed in an oven designed for minimum drift at maximum sensitivity. Stainless steel construction is used to eliminate danger of corrosion and contamination. 2) The temperature controller, continuously variable from 30 degrees C. to 350 degrees C. Proportional control assures accurate temperature monitoring, free from variations in ambient temperature, and independent of fluctuations in line voltage. 3) The bridge circuit and power supply—a specially designed wheatstone bridge for use with flake thermistors.



★ ★ ★

The **Apparatus Division, Hunter Spring Co.**, Lansdale, Pa., has developed thirteen new precision mechanical force gages capable of holding the maximum reading after the load has been removed. Added to the five similar gages announced earlier this year, this completes the conversion of the standard line of Hunter Force Gages to provide eighteen "hold-maximum" gages having an overall range of measure-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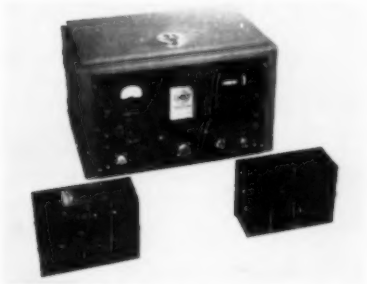
ment capacities of from 0-500 gm to 0-200 lb. The instruments are used for making force measurements, both in tension and compression, especially in awkward positions where it is difficult to read the gage in the measuring position, where measurements cannot be held steady and for measuring such momentary loads as peaks and break-points. The new gages may be held and operated in one hand. A single control button selects the desired gage operation, either to hold the maximum reading or to follow all load fluctuations. If set to record maximum load, the single dial pointer remains at the peak reading until released by touch of the button. There is no follower pointer to be reset after each measurement. The gages are capable of measuring all forces up to their maximum capacities with an accuracy of plus-or-minus ½ dial division or about ± ½ percent of full scale reading. Each gage is equipped with 4 interchangeable compression heads and an extension hook.

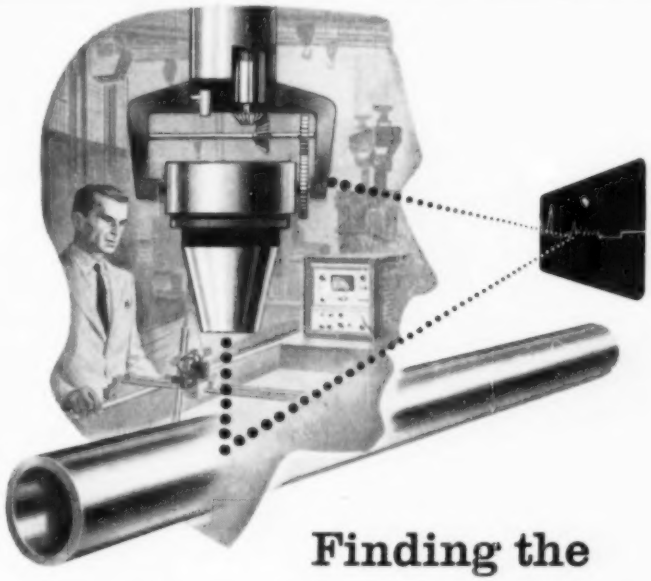
★ ★ ★



A photoelectric instrument designed to detect light changes in the microlumen range is in production at **Lindly & Company,** Mineola, N. Y. The operating sensitivity of the unit is adjustable within a wide range of light change limits to meet specific requirements. Generally, the instrument is designed to detect deviations from "normal configuration" of solids, liquids, and visible gases passed before the eye of the unit. For instance, the Lindly instrument is being used in the textile industry for detecting flaws, counting and maintaining quality control in yarn production. Variations in wire, vapor, webs, or filaments of any material may be automatically detected, counted, and, if desired, a stop motion actuated. In a length of nylon yarn, containing multi-filaments each measuring one and one-half ten-thousandths of an inch, the unit will detect a minute break of one of the filaments with equal accuracy at all times across any distance up to 25 feet.

★ ★ ★

The **W. H. Brady Co.,** 727 West Glendale Avenue, Milwaukee 9, Wis., have made available self-adhesive write-on labels as an aid to inspection. The self-sticking labels take pen, pencil, ball point or typewritten information and are coated with an adhesive that sticks and stays stuck to any clean dry surface, yet comes off clean when purposely removed. The labels come mounted on 9 inch long pocket-size dispenser cards that function as a portable writing board. This enables the user to write and apply the label "on the spot" in seconds. The dispenser card can be inserted in a typewriter for listing detailed copy. The labels are stocked in two different materials: vinyl cloth and 0.003 inch aluminum foil. Colored pencils, inks, etc., give a highly visible contrasting legend to the message area on the vinyl cloth and aluminum foil labels. The normal pressure of writing, dating, part numbering, initialling on the aluminum foil label imbeds the legend in the foil with a permanence that is difficult to alter with-

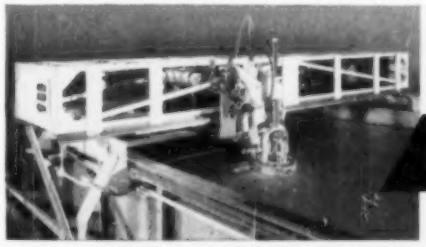



**Finding the invisible with the inaudible**

An engineer once said: "With ultrasonic inspection, you're finding the invisible with the inaudible."

Curtiss-Wright's Nondestructive Ultrasonic Test Equipment uses high frequency mechanical vibrations—far beyond the range of human hearing—for precision production-quantity inspection of forgings, rolled plate, welded tubing and other metal products. The "sound head"—immersed in water—sends vibrations that penetrate the metal under test and bounce back. Flaws show up on a cathode ray tube . . . and, simultaneously, a built-in alarm system sounds.

Curtiss-Wright Ultrasonic Inspection now controls quality for many leading producers in aircraft, steel, automotive, nuclear and other industries. Investigate its potentials for your production. Write for complete details.



Ultrasonic Immersion Test Equipment automatically scans wingskin plates for aircraft.

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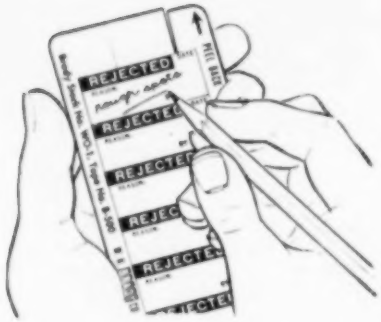
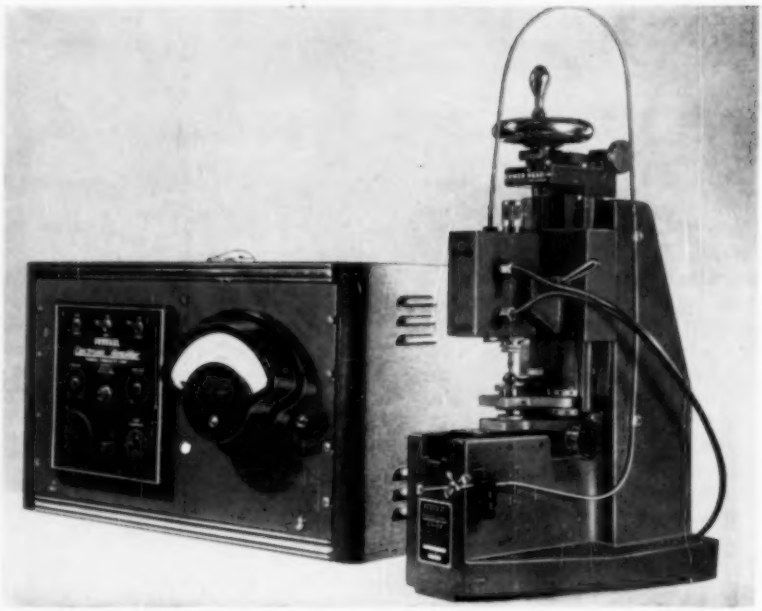



out detection. Eighteen different types of Brady Write-On Labels are carried in stock. Stock legends like "Rejected," "Accepted," "Hold," etc. are furnished on self-sticking vinyl cloth. Each legend has a bright identifying color on the label to aid at-a-glance inspection and calibration. Blank labels are stocked in both vinyl cloth and aluminum foil in sizes ranging from ¼ × 1½ to 1½ × 1½ inches. Special labels of any size, shape or color can be made to suit customer's specifications.

★ ★ ★

Dimensional variations as small as one millionth of an inch can be detected with a super-sensitive Electronic Comparator recently developed by **Federal Products Corp.**, 1144 Eddy Street, Providence 1, R. I. The Model 130 B-9, Millionth Comparator, was originally built to measure precision ball bearings but it is completely adjustable and may be used for parts of various shapes



and sizes. The Gage consists of three parts, an Electronic Amplifier, and Indicating Meter and an Electronic Gage Head mounted on a substantial base with an adjustable column to permit vertical positioning of the Gage Head assembly. The Gaging Spindle is mounted within the Gage Head on pantograph reed springs rather than in bushings to provide frictionless motion transfer. This makes it sensitive to the minutest variation in workpiece size and gives it exceptional repetitive accuracy. The construction also makes it possible to measure with a minimum gaging pressure so that thin-walled or highly polished parts can be measured without fear of distortion or marking. Any one of four magnifications can be selected quickly by switching. They range from 60,000 to 1 (0.000001 inch graduations) to 2,000 to 1 (0.000030 inch graduations). Ample electrical zero adjustment is provided and gage capacity is adjustable over a wide range.

# clinics, conferences, and forums

**June**

**24-25** • • • Automatic Controls for Heating and Air Conditioning, sponsored by ISA and ASHAE, Murray Bay, Quebec, write H. S. Kindler, director of technical programs, Instrument Society of America, 313 Sixth Avenue, Pittsburgh 22, Pa.

**August**

**28-30** • • • National Gas Chromatography Conference, sponsored by ISA Society of America, Michigan State University, East Lansing, Mich., write H. S. Kindler, director of technical programs, Instrument Society of America, 313 Sixth Avenue, Pittsburgh 22, Pa.

**September**

**4-11** • • • Advance Conference Series, Rutgers University, New Brunswick, N. J., write to Ellis R. Ott, University College, Rutgers University, New Brunswick, N. J.

**5-6** • • • "QC and the Consumer," 2-day conference, Rutgers University, New Brunswick, N. J., write to Ellis R. Ott, University College, Rutgers University, New Brunswick, N. J.

**8-13** • • • Second Annual Investment Castings Course, Massachusetts Institute of Technology, sponsored by the Investment Casting Institute, Chicago.

**9-10** • • • 4th Annual Western Regional Conference, San Francisco, Calif., write Allan M. Hull, United Air Lines, San Francisco in Airport, San Francisco, Calif.

**27** • • • Regional Technical Conference, "Hot Runner Molding," Hotel Niagara, Niagara Falls, N. Y., sponsored by Society of Plastics Engineers, Inc., contact R. W. Miler, 3 Hillview Center, Lewiston, N. Y.

**October**

**8** • • • Regional Techincal Conference, "Isocyanates," Curtis Hotel, Minneapolis, Minn., sponsored by Society of Plastics Engineers, Inc., contact Paul Becker, Honeywell Regulator Co., 2733 4th Ave. South, Minneapolis, Minn.

**17** • • • Regional Technical Conference, "Polyethylene," Hotel Carter, Cleveland, Ohio, sponsored by Society of Plastics Engineers, Inc., contact W. A. Messina, 23817 Cliff Drive, Bay Village, Ohio.

**18-19** • • • First Annual QC Technical Conference, sponsored by the Chemical Division, ASQC

A new internal measuring instrument featuring an optical vernier has been introduced by the **American Gauge Corp.** The instrument, called the OPTO-MIKE, permits quick, easy bore measurements while eliminating the need for critical alignment or special operator skill or "feel." A measurement with the OPTO-MIKE is accomplished by inserting the instrument at an angle into the bore, with the measuring anvil retracted. The measuring anvil is then released and the OPTO-MIKE is swept once a few degrees, then carefully withdrawn and the true measurement is easily read on the 23-power optical vernier. The OPTO-MIKE is available in matched sets for internal measurements from 0.800 to 6.000 inches. For further information and prices, write to the American Gauge Corp., 575 Bloomfield Avenue, Verona, N. J.

★ ★ ★

The **Jarrell-Ash Co.**, 26 Farwell Street, Newtonville 60, Mass., has introduced a high precision quartz crystal X-ray goniometer that permits unskilled operators to orientate crystal surface and lettice planes quickly to accuracy within 30 seconds of arc. Produced by Hilger & Watts Ltd., British instrument manufacturer, the Model Y-130 Quartz Crystal X-Ray Goniometer was developed to meet the increasingly rigid demands of crystal users within the electronics industry for a fast, simple means of accurately checking plane alignment of cut quartz and other crystals. Among the features of the instrument are a large direct reading scale, simple controls, and a higher sensitivity than required for even the weakest


AMES

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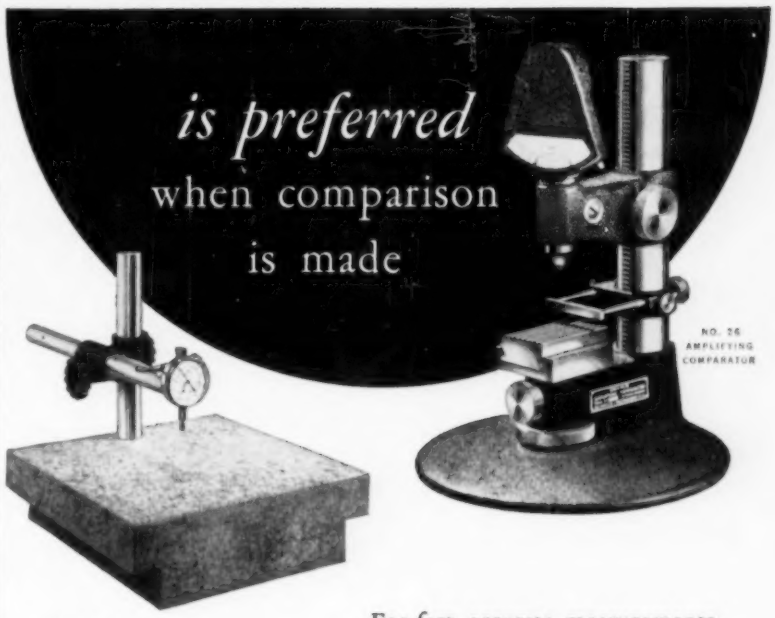
when comparison
is made

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For fast, accurate measurements, Ames Dial Comparators are the choice of quality control men everywhere. You get definite, impersonal readings directly from the dial. There's no guesswork or figuring.

Special comparators are available for measuring resilient materials such as rubber, paper, etc., and for measuring non-yielding materials such as sheet metal, glass and plastic. Write for complete details.

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crystal reflections. The goniometer is suitable for routine testing of both large and small crystal blanks, and may be used with either a high intensity micro-focus x-ray unit or with conventional x-ray diffraction equipment.

* * *

A new technique for measuring the fluidity of molten metals has been developed by Dr. David Rugone, of the University of Michigan. The Rugon Fluidity Tester provides the foundryman with a tool to quickly, reliably and easily measure the fluidity of metals by using a controlled partial vacuum to pull a sample of metal into a preformed, precision pyrex tube. The tester is self contained and portable; weighing only 9½ pounds. The uncontaminated sample may be used for chemical analysis if desired. The tester is manufactured and sold by the **Harry W. Dietert Co.**, 9330 Roselawn Avenue, Detroit 4, Mich.

* * *

A new type altimeter, accurate in the high altitude ranges of from 75,000 feet to 225,000 feet has been announced by **Hastings-Raydist,** Inc. of Hampton, Va. This instrument makes possible accurate altitude measurements in a range which heretofore has been very difficult to measure. The altimeter operates on 115 volts a.c., is unaffected by ambient temperature changes and provides continuous direct altitude reading or recording. It has a rapid response to altitude changes, holds calibration indefinitely, and is unharmed by sudden exposures to any atmospheric pressure. The transducer used has an internal volume less than 1/20 cubic inch, and measures altitude by means of a low pressure sensing element. This transducer, a noble metal thermopile, generates a d.c. voltage which is inversely proportional to pressure. The output voltage of the thermopile increases with increasing altitude. At the higher altitudes this sensing element, without moving parts, becomes much more sensitive than the usual bellows or capsule types of pressure indicators. Maximum sensitivity is in the range of a few millimeters of mercury. The Hastings Altimeters have been calibrated based on the latest altitude reference, the Air Force Research Development Command Model Atmosphere, adopted in 1956 and to be published in 1957. The new Hastings Altimeter offers wide possibilities of accurate high altitude measurements for altitude chambers, wind tunnels, environmental testing, and aircraft, rocket and missile research.


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A new type of measuring instrument is announced by **Gaertner Scientific Corp.**, 1201 Wrightwood Avenue, Chicago 14. Called coordinate cathetometers, these new instruments make both a horizontal and vertical measurement in a vertical plane at one setting. The coordinate cathetometer consists of a microscope or telemicroscope mounted on a carriage which is moved up and down on an accurately-scraped vertical bar. This assembly is moved left to right or vice versa on accurate horizontal ways. Fine motion adjustment is provided by precision micrometer screws. The units are well-suited for precision measurements on large objects; and on objects or points in recessed, remote or inaccessible locations. They are useful in measuring jet engine sections, complicated castings, printed circuits, bolt holes and bosses on large piece parts, traces on cathode ray tubes, etc. Coordinate ranges from 2 × 2 up to 42 × 24 inches are available in both the English and Metric systems.

★ ★ ★

The Model P-3 Insulation Tester Combination has been developed by **Peschel Electronics Inc.**, 15 Garden Street, New Rochelle, N. Y. This instrument combines a sensitive hipot tester with a fault indicator and counter for continuous production use in the manufacture of insulated wire or other material. This dual unit allows the testing of two distinct types of insulation faults: pinholes and substandard insulation. Having two separately variable power supplies, it becomes possible to descriminate between the two

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types of faults which are voltage sensitive. By energizing the forward electrode with a suitably low potential (100 volts) and the following electrode with high voltage (up to 20,000 volts) it is possible to obtain separate indications and counts for both pinholes and substandard insulation, thin spots, contaminated insulating material or lack of centering of a wire within plastic insulation.

★ ★ ★

## NEW LITERATURE

The Burgoyne Testing Laboratories, 542 Main Street, Westbury, Long Island, announces the release of a new 24 page brochure covering the complete facilities available in Environmental, Metallurgical, Chemical and Quality Control Testing.

## POSITIONS AVAILABLE

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### QUALITY CONTROL ENGINEER

To establish quality control procedures on new products; to design and follow through statistical experiments determining capabilities, error of measurement, plus cause and effect relationships; to establish expected yield; and determine quality standards on inprocess and finished product. 3-5 years experience in metal working field desired. Engineering degree required. Please send resume and salary requirements to:

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To assist in the development of a dynamic plant-wide program of defect prevention. Duties will include: establishing quality aduit systems, analysis of quality problems, and design of process experiments. Qualifications are: degree in Engineering plus training in statistics and up to 5 years active experience in quality control methods. Experience in the electrical wire and cable industry helpful but not essential. Write, giving complete resume of training and experience to:

Personnel Manager
The Electric Auto-Lite Company
Wire and Cable Division
Port Huron, Michigan

## POSITIONS WANTED

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Presently employed, Quality Control Administrator, age 38; fluent in French and English; fifteen years in the electronic field (radio, TV, home appliances, etc); five years in Quality Control. Experienced in the design, selection and administration of sampling plans and control charts and in the supervision of personnel. Varied experience with the setting up and administration of statistically founded experiments. Will relocate anywhere in Canada or USA. B.S. degree; senior member ASQC. For complete resume, please reply to Box 14A1 at the above address.

Analytical Chemist, 31, B.S. degree, desires position as quality control manager. Thorough knowledge of and experience in statistical Q.C. and design of industrial experiments. Especially suitable for food, pharmaceutical, or chemical industry. Please reply to Box 14A2 at the above address.

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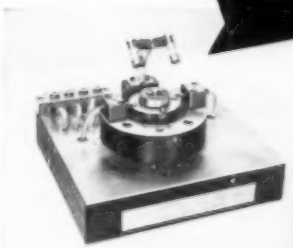

**Special Air Gaging Fixtures** designed and built to meet your particular application requirements. Complete engineering service available upon request.

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- Easy-to-read Zero-centered scales permit use of instrument for normal inspection, statistical quality control, and as a tool setting gage.
- Interchangeability of component parts simplifies conversion from one amplification to another, reduces spare parts inventory costs.

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Typical Series 205 Gage (12 Basic Models)

Squareness and location of holes in three mating parts of pump are checked to determine alignment within .0001".

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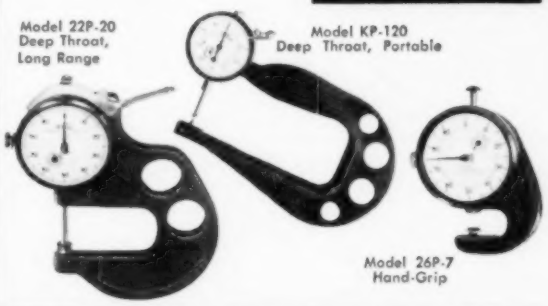
Many styles and sizes, for portable and bench use.



Model 22P-20 Deep Throat, Long Range

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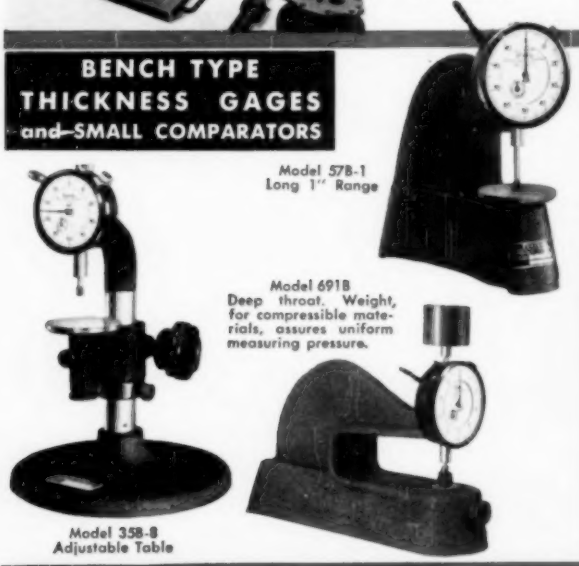
Model 26P-7 Hand-Grip

### BENCH TYPE THICKNESS GAGES and SMALL COMPARATORS



Model 57B-1 Long 1" Range

Model 691B Deep throat. Weight, for compressible materials, assures uniform measuring pressure.

Model 358-B Adjustable Table

### OVER 10 TYPES OF COMPARATORS

Model 130B-9 Electronic Comparator, Ball Bearing. Detects one millionth.

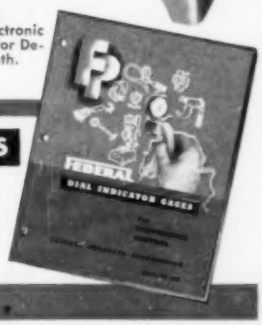
Model 136 I.D. — O.D. Electronic Master Comparator Detects one millionth.

*Whatever You Need in Gages . . .*

*Ask* FEDERAL *First*

### MANY OTHER TYPES

**Send for Catalog showing most complete line of Dial Indicator Gages.**




**GAGES CAN BE SPECIALLY MODIFIED TO SUIT . . .**